CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

General Analysis Procedures

The inherent physical properties of a watershed combined with vegetative cover and climatic factors determine, to a great extent, the nature of runoff, groundwater recharge, stream-flow, and aquatic habitat. Recent efforts on the GMUG to address watershed conditions include the 1997 R2 Watershed Assessment and subsequent multi-region Inland West Watershed Initiative (IWWI) completed in 2000. Although only limited quantitative data was utilized, they established a reasonable framework for qualitative evaluation of the factors determining watershed condition (integrity, vulnerability, and values).

Increased data availability and enhanced GIS capabilities now permit a more quantitative approach to watershed evaluation. This assessment separately addresses physical sensitivity and management activities, and then combines those results into a hydrologic integrity rating. The lack of direct measures of overall physical sensitivity, cumulative effects of management activities, or hydrologic integrity necessitated a "probabilistic" approach similar to that employed for the Interior Columbia Basin Assessment by Quigley et al.(1996). Surrogate variables are used to approximate underlying processes, and then summarized to make inferences about likely conditions or trends. While the various results cannot be considered absolutes, they are useful for plan level screening or comparison of sub-watershed conditions across the forest.

Forest soils, hydrology, and fisheries specialists participated in development of this procedure, which relies on coarse scale (sub-watershed) measures of physical sensitivity, management activities, and values. The general process and results are consistent with other analyses, including the Hydrologic Condition Analysis (HCA) framework of the Forest Service and Bureau of Land Management (McCammon et al, 1998), Ecosystem Analysis at the Watershed Scale (USDA and USDI, 1996), Index of Watershed Indicators (US EPA, 2002), and Region 2 Species Conservation Project Aquatic-Riparian-Wetland Assessment (2004).

The assessment results are meant to satisfy a number of objectives:

- A framework for rating and comparing sub-watershed condition and trend across National Forest Lands.
- Input for Forest Plan land allocations, suitable uses, and appropriate guidelines.
- Watershed/Fisheries program emphasis areas (inventory and monitoring, needs, restoration, identification of potential reference watersheds).
- Development of baseline data for project level NEPA analysis.

The assessment was done at the 6th level Hydrologic Unit Code (HUC) scale (sub-watershed) for lands within the proclaimed boundaries of the Grand Mesa, Uncompahgre,

Gunnison National Forests (GMUG lands) only. The scale and extent are analogous to the "Management" scale employed in the R2 SCP ARWA procedure. Portions of 225 sub-watersheds lie within the administrative boundaries of the GMUG National Forests, and range from 1,000 to 120,000 acres in total size (Figure 5A-1). Although the range in total size is broad, most (80%) are between 5,000 and 45,000 acres (Figure 5A-2). The Forest Service manages from as little as 7 to as many as 97,690 acres and from less than 1 % to 100% of these sub-watersheds. The extent of National Forest System lands (NFS) within each sub-watershed must be considered during any interpretation of the results.

Methods

To address the principal objectives, three separate categories of information were assembled for the National Forest portion of each sub-watershed:

1. Physical Sensitivity – physical environmental factors that determine inherent response to disturbance (natural or management related). {variables include stream density, runoff potential, potential erosion hazard, annual rainfall energy, and the extent of low gradient response channels.}

2. Management Activities – the variety of management activities or impacts that have occurred. {variables include roads & motorized trails, diversion numbers & amounts, reservoirs, mining, and vegetation treatments, and streamside recreational use}

3. Values – aquatic related social and ecological values present and potentially affected. {variables include TES presence, water yield, riparian cottonwood galleries, low gradient response channels, riparian and wetlands, special water-dependent communitie ,water uses, and recreation uses}

The individual variables included, and units of measure used to determine current conditions are summarized in Table 5A-1. A fuller description of each factor, and data sources utilized is included as Appendix A.

Current forest-wide information was evaluated and analyzed in the following general sequence:

1. Physical sensitivity factors

2. Management activity factors

3. Hydrologic Integrity (integration of sensitivity & activity results)

4. Values present

5. Synthesis & Interpretation of Hydrologic Integrity and Values

The remainder of this section describes only the analytical aspects used during that sequence. Subsequent sections (5.B thru 5.E) discuss detailed results.

Physical Sensitivity and Management Activities Analysis Steps

A four-step process was applied to characterize overall physical sensitivity and management activity levels. The sensitivity and activity analyses are discussed in sections 5.B and 5.C respectively, with complete results available in Appendices B & C, and summarized in Appendix D.

Step 1 – Calculate Relative Variables.

Initially, all variables are expressed in relative terms such as percent of the sub-watershed area, percent of the stream or blue line (perennial & intermittent only) channel network, or occurrences per square mile etc. (see Table 5A-1). Although the initial results may be utilized individually to compare sub-watersheds based upon a particular variable of interest, the ultimate objective is an integration of the individual results that reflect overall sensitivity as well as activity levels for each sub-watershed.

Step 2 – Determine Standardized Variables.

The initial relative values for each variable were divided by the forest-wide maximum observed. For example, stream density ranges from 0.0 (no channels within GMUG boundaries) up to a maximum of 8.9 channel miles per square mile. The initial calculated stream density for each sub-watershed was divided by 8.9 to determine its standardized stream density. As a result, all standardized variables range from 0 to 1.00, which represents from 0% to 100% of the maximum observed value.

Step 3 – Sum Standardized Variables.

Overall or aggregate totals were determined for each sub-watershed by summing all its standardized variables. The aggregate totals may be used to compare overall physical sensitivity or management activity levels between sub-watersheds. Larger totals are indicative of greater physical sensitivity or management activity levels. It is important to recognize that the results reflect only conditions within the GMUG boundaries.

This method of approximating over-all sensitivity and activity levels gives equal influence or weight to each variable included in the summation. Although intuitively there are differences, no established or widely accepted basis to objectively assign differential weighting exists. Table 5A-2 is representative of the summation step in estimating sensitivity for the sub-watersheds within the Razor Creek area southeast of Gunnison.

Table 5A-2. Example of standardized sub-watershed sensitivity variables and totals.

	Acres within GMUG	Rainfall Intensity Factor	Stream Density	Severe & Very Severe Erosion Risk	High Runoff Potential	Adjustable Stream Channels	Total
Upper Razor Ck	22,203	0.55	0.30	0.34	0.39	0.29	1.88
Prosser Ck	2,547	0.44	0.38	0.25	0.34	0.00	1.40
Lower Razor Ck C	1,270	0.30	0.22	0.14	0.30	0.00	0.96

Step 4 – Classification Based on Overall Sensitivity and Activity Levels.

To facilitate interpretation of the results, the continuum of aggregate totals (for both physical sensitivity and management activity levels) was divided into 4 classes using the 'Jenks natural breaks' method available in ArcMap. Thus, each sub-watershed was placed into 1 of 4 sensitivity classes, and 1 of 4 activity classes. In each case, class 1 includes the sub-watersheds with the lowest relative totals (least sensitive, least management activities) and class 4 the highest relative totals. This method maximizes within-class similarity in conjunction with the highest degree of between-class dissimilarity. This scheme is robust and widely used by cartographers (Kumar, 2002).

Sub-watershed Hydrologic Integrity

The mathematical product of the physical sensitivity and management activity totals (from Step 3 above) was used as an approximation of overall hydrologic integrity for each sub-watershed. Small products suggest higher relative integrity and large products lower relative integrity. The complete set of hydrologic integrity estimates was also classified into 4 groups using the ' Jenks natural breaks' method in ArcMap. Class 1 includes GMUG sub-watersheds with the highest, and Class 4 those with the lowest relative integrity. The integrity results are discussed in section 5.D, and full tabular results presented in Appendix D.

Values present

Watersheds and associated streams provide for a broad range of ecological and social values. Those values may be present within the GMUG boundaries or downstream. The State of Colorado has established water quality standards and policies to protect and sustain a number of beneficial uses (recreation, agriculture, domestic water, and wetlands). Available information related to each of those use categories was assembled and summarized by sub-watershed.

Inherent conflict between some of those uses or values made development of a sub-watershed ranking or classification based on a "total values" problematic. However, the extent of each value was estimated and used in conjunction with the sensitivity, activity, and integrity results to develop various management and program area recommendations.

Synthesis & Interpretation

The assessment results were used to recommend aquatics based suitable uses and or desired management themes on a sub-watershed or smaller basis.

Figure 5A-1. GMUG NFs and HUC6 boundaries.

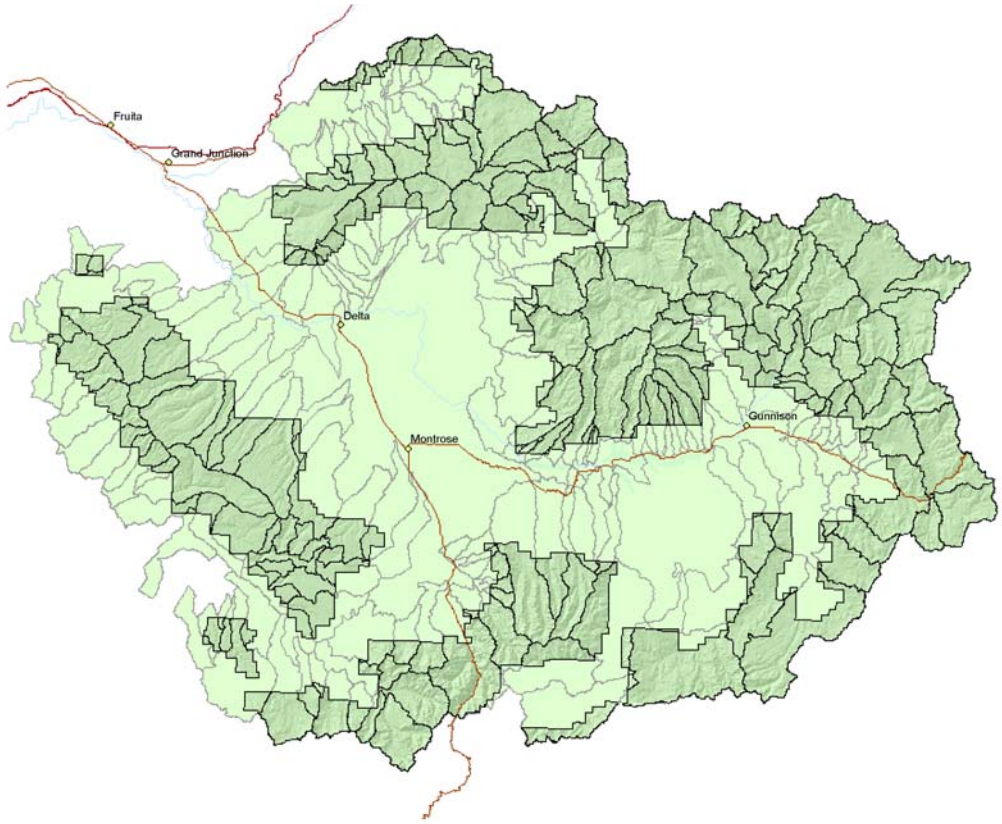


Figure 5A-2. Distribution of HUC6 total acres

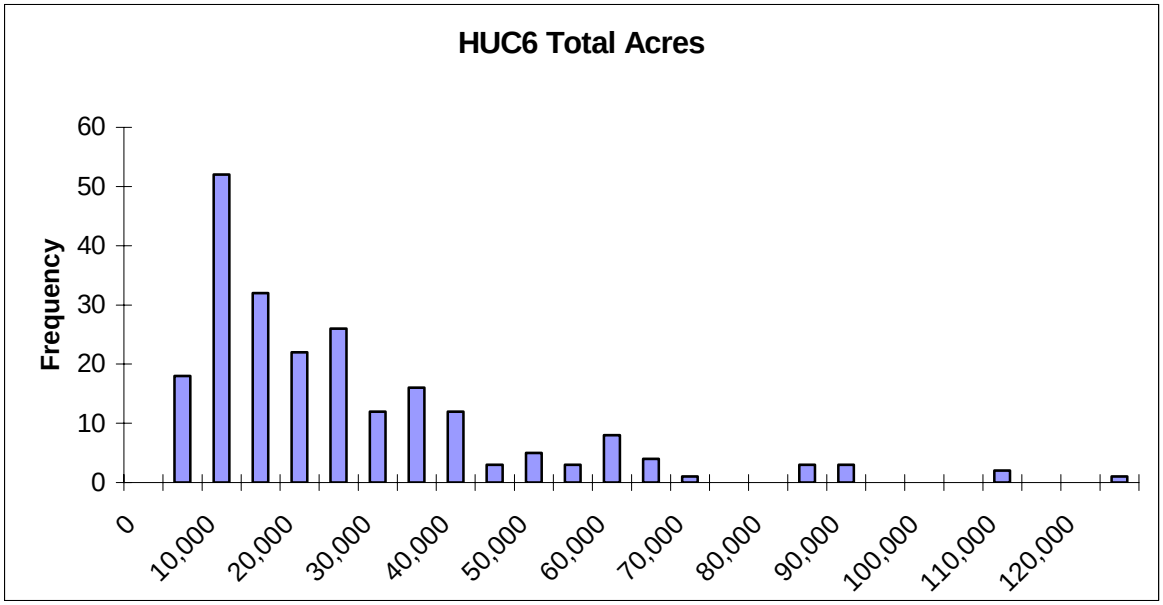


Table 5A-1. Variables examined in the GMUG sub-watershed condition assessment.

PHYSICAL SENSITIVITY	UNITS
stream density	mi/sq mi
erosion hazard (severe + v severe)	% of ws
low gradient response reaches	% of net
rainfall intensity index	wtd ave of ws
hydrologic group	wtd ave of ws
LAND USE / MANAGEMENT ACTIVITIES	
high streamside recreational use (pathfinder dispersed survey, developed sites along streams)	% of net
private inholdings	% of ws
stream miles below diversions	% of blue line
stream miles below reservoirs	% of blue line
stream miles inundated by reservoirs	% of blue line
vegetation treatments (timber mgt, utility corridors, ski runs, roller chopping, hydroaxe etc.)	% of ws
road & motorized trail density	mi/sq mi
road & motorized trail stream crossing density	#/sq mi
buffered riparian road & motorized trail density	mi/sq mi
active & abandoned mine adits & tailings	#/sq mi
VALUES	
Ecological	
aquatic TES	presence/absence
water dependent botanical TES	presence/absence
water yield	inches/unit area
riparian cottonwood stands	stream miles
low gradient response reaches	stream miles
riparian and wetlands	acres
special water-dependent plant communities	#/sq mi
Social	
public drinking water supplies (based on % of source area wihin GMUG boundaries)	>= 70%
general recreation	stream miles
recreational fishing	stream miles
water uses	ac-ft diverted

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Physical Sensitivity

The physical sensitivity of a sub-watershed is an estimation of its potential response to current or future land disturbances (natural or management related). The variables selected to characterize physical sensitivity are related to sediment and runoff generation, and subsequent routing through the channel network. They reflect inherent physical factors, which are not subject to short-term change or modification (geologic parent materials, landforms, topography, and climate).

The evaluation of individual variables, as well as the resultant overall sub-watershed sensitivity considers only conditions within the GMUG forest boundary. The detailed information available and used to derive overall sensitivity on the Forest is currently not available across entire sub-watersheds. As a consequence, how these GMUG-focused results would compare to a similar analysis of all lands comprising a sub-watershed is unknown. However, GMUG lands typically occupy the higher elevation, wetter, and steeper portions of the sub-watersheds.

A more complete discussion of computational details and terms is contained in section 5.A, but in summary these results reflect relative not absolute differences between sub-watersheds. Those sub-watersheds with lower totals (sum of standardized variables) reflect lower physical sensitivity relative to those with higher totals. Therefore, they would be expected to have greater tolerance to disturbance. Conversely, those sub-watersheds with the highest totals are more sensitive and expected to be less tolerant or more responsive to disturbance.

A key product of the analysis is the classification or categorization of all the sub-watersheds into classes based on overall physical sensitivity, in order to facilitate various interpretations.

Key Findings

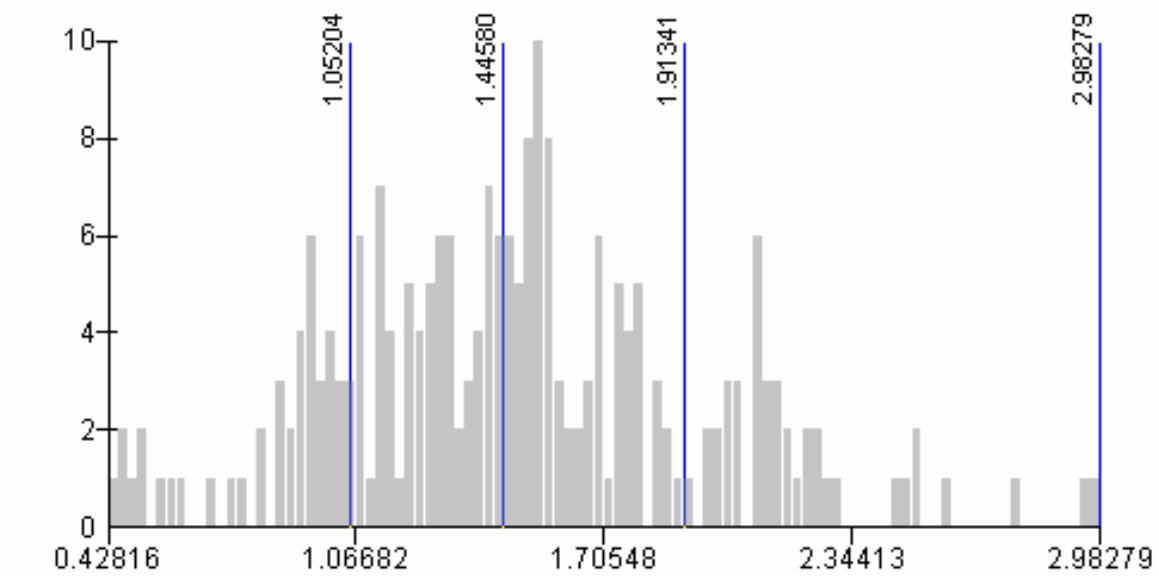
- Sub-watersheds in the highest relative physical sensitivity class (4) may have a high level of a single factor or variable, or moderate level of many factors.
- Roughly 5 % of GMUG lands are in the lowest relative physical sensitivity class and 28 % in the highest.
- The highest class (4) generally reflects portions of the forest with the highest topographic relief.
- The least sensitive sub-watersheds (class 1) occur on more moderate terrain, and have no low gradient response stream channel segments.

Results

Theoretically the highest total in the analysis is 5.00 because the 5 standardized sensitivity variables used in the summation range from 0.0 to 1.00. The actual highest total for GMUG sub-watersheds is 2.98 (Lower Plateau Creek Composite sub-watershed), while the lowest is 0.43 (Spring/Pool Gulches). The complete distribution of calculated physical sensitivity totals is illustrated in Figure 5C-1 along with the 'Jenk' class or group breaks. Sub-watersheds with totals between 0.43 and 1.05 are placed in Class 1 (least sensitive), from 1.07 – 1.45 Class 2, from 1.45 – 1.91 Class 3, and > 1.91 are categorized as Class 4 (most sensitive).

The distribution in Figure 5-1 resembles that of a normally distributed ('bell shape') population. Approximately 80% of all sub-watersheds have aggregate totals between 1.00 and 2.10.

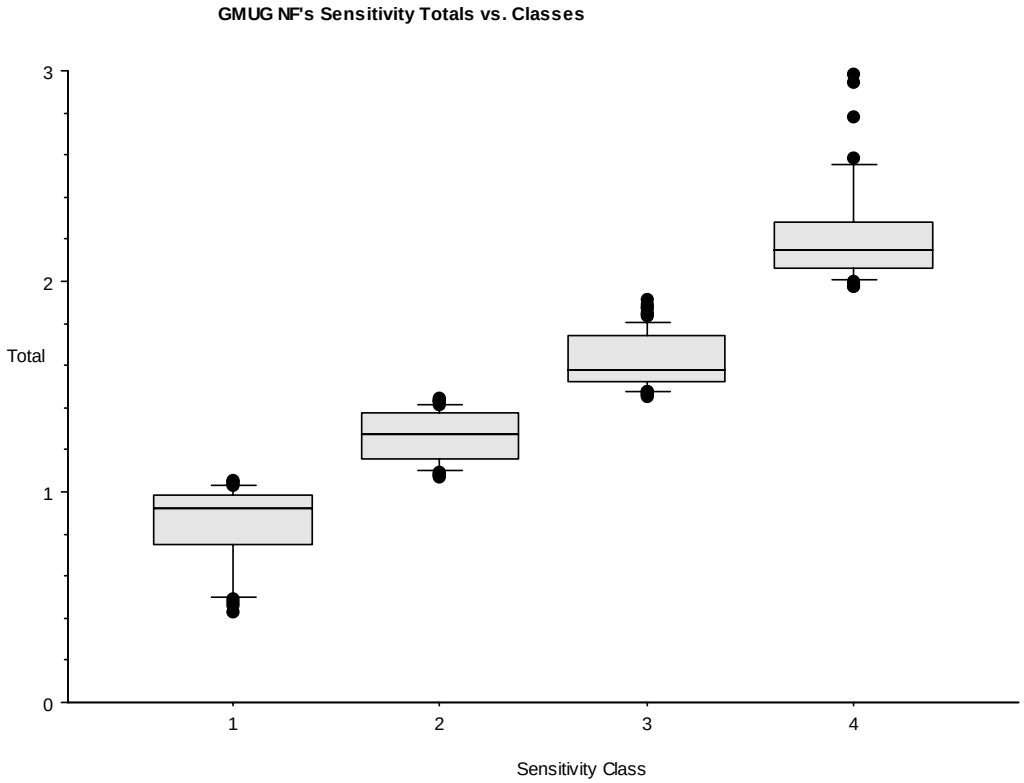
Figure 5B-1. Frequency Distribution of Sub-Watershed Physical Sensitivity Totals and Class Breaks.



Class 1 Class 2 Class 3 Class 4

The 'box and whisker' diagram of Figure 5B-2 illustrates the final classification results in a different way, portraying various statistical measures for each class or group. The central bar within each box represents the average totals for all sub-watersheds in the class, the solid boxes include the 25th thru 75th percentiles of scores in the class, the bars beyond the boxes represent the 10th thru 90th percentiles, and finally individual circles are those class members with totals outside the 90th and 10th percentiles. The overall lack of overlap between the classes suggests that the Jenk's breaks provide good separation between the classes. It is also clear that the overall variation in total scores is less for the middle 2 classes than for the extremes.

Figure 5B-2. 'Box and Whisker' diagram of the final physical sensitivity classification.



Ultimately, about 5% of the area within the GMUG is placed into Class 1, 20% is in Class 2, 47% in Class 3, and 28% in Class 4. Figure 5B-3 is a map showing the spatial distribution of the final physical sensitivity classes.

The predominance of classes 3 and 4 reflects the rugged headwaters nature of most of the GMUG. Several areas of highest sensitivity (Class 4) are apparent and include the Battlements near Plateau Creek, the San Juan Mountains to the south and the Elk and Sawatch Mountains to the northeast and east. High relief is common to all these areas resulting in high potential erosion, runoff, and stream density in all these areas.

Lower classes (1 and 2) are generally limited to the Uncompahgre Plateau, Grand Mesa, and Sawtooth Mountain (NW of Cochetopa Creek) areas, or small portions of sub-watersheds flanking steeper mountain ranges, where more subdued terrain prevails.

Figure 5B-3. GMUG Sub-Watershed Physical Sensitivity Classes

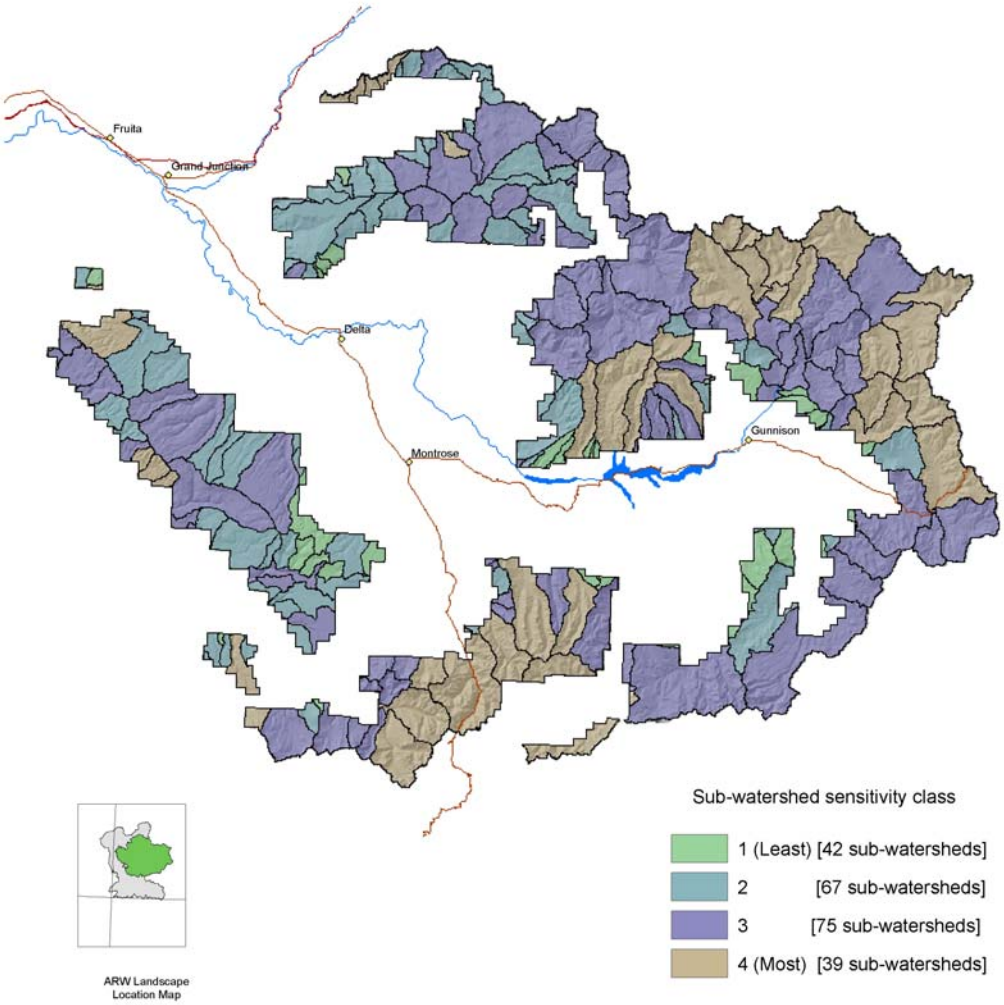


Table 5B-1 includes the 39 sub-watersheds in the highest relative physical sensitivity class (4) arranged in descending order of the total. These watersheds all have aggregate totals greater than or equal to 1.98. All have at least one standardized variable which is 58% or more of the forest-wide maximum observed, and the ten highest have at least one standardized variable ranking at 80% or more of the maximum.

These tabular results illustrate the continuum of aggregate totals for the sub-watersheds grouped in the highest physical sensitivity class. It also demonstrates the varied ways of being placed in the class. Whether by a single high standardized variable as in the case of Upper West Creek on the north end of the Uncompahgre Plateau and Naturita Creek south of Norwood with high proportions of low gradient adjustable channel segments or in the case of Shavano, Campbell, and Spring Creeks on the west slope of the Plateau a number of more modest standardized variable estimates.

Table 5B-2 includes the 42 sub-watersheds in the least sensitive class (1). Aggregate totals within the class range from 0.43 to 1.07. The low values for erosion and runoff

potential reflect more modest terrain and deeper soils versus the sub-watersheds in Class 4. And none of the GMUG portions of Class 1 sub-watersheds include low gradient adjustable channel segments.

Table 5B-1. Sensitivity Class 4 Standardized Variables Results.

HUC6	HUC6 NAME	Acres within GMUG	% of Sub-watershed within GMUG	Rainfall Intensity Factor	Stream Density	Severe & Very Severe Erosion Risk	High Runoff Potential	Adjustable Stream Channels	total	class
140100051701	Lower Plateau C	6,013	9.6	0.37	1.00	0.64	0.97	0.00	2.98	4
140100051702	Anderson Gulch	3,656	42.5	0.38	0.85	0.80	0.91	0.00	2.94	4
140200019907	Mid East Rvr C	15,769	95.6	0.77	0.39	0.42	0.20	1.00	2.78	4
140200067901	Upper Uncompahgre Rvr	63,451	73.4	0.61	0.46	0.86	0.57	0.09	2.59	4
140200019508	Texas Ck	25,945	100.0	0.88	0.21	0.44	0.15	0.84	2.51	4
140200064801	Upper Cow Ck	28,320	89.4	0.62	0.54	0.81	0.46	0.08	2.51	4
140300046903	Wright/Casto Draws C	166	1.3	0.48	0.00	1.00	1.00	0.00	2.48	4
140200019910	Upper East Rvr	11,334	100.0	0.98	0.36	0.65	0.18	0.31	2.47	4
140300046901	Upper West Ck	29,860	48.6	0.47	0.36	0.34	0.27	0.88	2.32	4
140200039304	Upper Quartz Ck	25,919	100.0	0.93	0.29	0.58	0.31	0.18	2.29	4
140200019909	Copper Ck	5,886	100.0	1.00	0.30	0.80	0.17	0.00	2.27	4
140200039301	Lower Quartz Ck C	24,534	79.3	0.61	0.42	0.44	0.34	0.45	2.25	4
140300036702	Shavano Ck	3,646	46.9	0.73	0.66	0.33	0.53	0.00	2.24	4
140200020302	West Elk Ck	19,072	96.8	0.70	0.54	0.83	0.15	0.00	2.23	4
140200028101	Cimarron Rvr	46,322	55.8	0.61	0.50	0.64	0.30	0.14	2.20	4
140300036303	Upper San Miguel Rvr C	32,669	99.7	0.59	0.33	0.72	0.33	0.22	2.19	4
140300036703	Campbell Ck	7,360	41.5	0.72	0.62	0.35	0.48	0.00	2.17	4
140200019905	Farris Ck	4,267	90.3	0.72	0.28	0.44	0.24	0.48	2.16	4
140200039103	Upper Tomichi Ck	58,230	100.0	0.85	0.38	0.40	0.06	0.46	2.15	4
140200028303	Upper Lake Fk	19,861	41.3	0.65	0.28	0.58	0.47	0.16	2.15	4
140200067903	East Fk Dallas Ck	12,263	62.9	0.64	0.32	0.67	0.38	0.12	2.13	4
140300036704	Spring Ck	4,685	34.7	0.58	0.58	0.48	0.49	0.00	2.12	4
140200019906	Brush Ck	24,673	100.0	0.80	0.33	0.61	0.17	0.21	2.12	4
140300036101	Naturita Ck	19,497	15.9	0.58	0.26	0.26	0.28	0.73	2.11	4
140200024901	Big Blue	27,470	75.7	0.52	0.29	0.59	0.26	0.45	2.11	4
140200019509	Upper Taylor Rvr	39,910	100.0	0.73	0.28	0.37	0.27	0.46	2.10	4
140100051706	Park Ck	5,381	91.2	0.79	0.41	0.15	0.38	0.37	2.10	4
140300036304	South Fk San Miguel Rvr	37,144	100.0	0.60	0.29	0.63	0.32	0.26	2.09	4
140200019507	Willow Ck	40,620	100.0	0.70	0.28	0.31	0.25	0.55	2.09	4
140100051703	Kimball Ck	4,783	66.2	0.61	0.55	0.47	0.42	0.00	2.05	4
140200019904	Cement Ck	21,953	97.4	0.68	0.37	0.55	0.27	0.17	2.05	4
140200019504	Lottis Ck	26,975	100.0	0.67	0.26	0.47	0.28	0.37	2.05	4
140200019908	Slate Rvr	45,688	79.1	0.78	0.27	0.52	0.15	0.31	2.03	4
140200039303	Gold Ck	19,457	100.0	0.79	0.30	0.57	0.37	0.00	2.03	4
140200025305	Curecanti Ck	21,136	84.2	0.60	0.40	0.60	0.05	0.37	2.02	4
140200020106	Castle Ck	14,099	97.0	0.66	0.39	0.42	0.08	0.44	2.00	4
140200028302	Hensen Ck	18,408	57.6	0.59	0.37	0.71	0.33	0.00	1.99	4
140200020301	Soap Ck	51,802	98.3	0.59	0.46	0.65	0.10	0.19	1.98	4
140200020310	Beaver Ck	17,286	74.8	0.66	0.43	0.72	0.09	0.08	1.98	4

Table 5B-2. Sensitivity Class 1 Standardized Variables Results.

HUC6	HUC6 NAME	Acres within GMUG	% of Sub-watershed within GMUG	Rainfall Intensity Factor	Stream Density	Severe & Very Severe Erosion Risk	High Runoff Potential	Adjustable Stream Channels	total	class
140300036505	Hanks Ck	5,035	100.0	0.49	0.37	0.11	0.08	0.00	1.05	1
140200038903	Wood Gulch	2,163	29.0	0.48	0.55	0.02	0.00	0.00	1.05	1
140200051304	Oak Ck	4,838	33.9	0.61	0.24	0.08	0.12	0.00	1.04	1
140200025402	Leaps Gulch	5,852	82.6	0.56	0.37	0.05	0.05	0.00	1.03	1
140300036504	Little Red Canyon	7,875	100.0	0.51	0.28	0.20	0.04	0.00	1.03	1
140200038704	Lower Cochetopa Ck C	10,562	18.3	0.42	0.24	0.15	0.21	0.00	1.02	1
140200051303	Doughspoon Ck	2,552	36.8	0.56	0.16	0.14	0.15	0.00	1.02	1
140200025001	Upper South Beaver	16,589	77.2	0.61	0.19	0.09	0.12	0.00	1.01	1
140200025403	Fischer Gulch	2,629	100.0	0.52	0.34	0.04	0.11	0.00	1.01	1
140300036506	Clear Ck	5,094	100.0	0.54	0.29	0.10	0.07	0.00	1.00	1
140300036103	Burn Canyon	823	25.0	0.38	0.26	0.03	0.32	0.00	0.99	1
140100051714	Spring Ck	2,532	28.9	0.59	0.25	0.01	0.12	0.00	0.97	1
140200025303	Mesa Ck	7,126	83.6	0.61	0.28	0.07	0.00	0.00	0.97	1
140200035103	Lower Razor Ck C	1,270	9.4	0.30	0.22	0.14	0.30	0.00	0.96	1
140200064002	Happy Canyon Ck	6,554	27.1	0.40	0.26	0.03	0.26	0.00	0.96	1
140200065001	East Fk Dry Ck	16,385	47.1	0.56	0.23	0.08	0.09	0.00	0.95	1
140300034703	Specie Ck	1,044	14.4	0.57	0.15	0.11	0.12	0.00	0.95	1
140200057504		24	0.1	0.39	0.00	0.00	0.56	0.00	0.95	1
140200028501	Rock Ck/Fish Canyon C	5,501	11.5	0.51	0.36	0.02	0.06	0.00	0.95	1
140200020101	Lower Ohio Ck C	16,593	43.8	0.49	0.34	0.07	0.03	0.00	0.93	1
140200051301	Dry Gulch	1,011	16.2	0.62	0.11	0.12	0.06	0.00	0.92	1
140200038905	Cabin Ck	3,823	54.5	0.52	0.36	0.01	0.02	0.00	0.92	1
140200025304	Myers Gulch	3,427	57.8	0.60	0.30	0.01	0.01	0.00	0.92	1
140200045803	West Roatcap Ck	311	4.6	0.91	0.00	0.00	0.00	0.00	0.91	1
140200025306	Corral Ck	1,687	42.8	0.56	0.34	0.00	0.00	0.00	0.90	1
140200028503	Powderhorn Ck	646	5.0	0.54	0.11	0.00	0.23	0.00	0.88	1
140200054003	North East Ck	3,258	41.6	0.53	0.30	0.04	0.00	0.00	0.88	1
140200025307	Haypress Ck	649	37.4	0.55	0.32	0.00	0.00	0.00	0.88	1
140200025308	Cottonwood Gulch	1,233	33.6	0.51	0.30	0.01	0.00	0.00	0.83	1
140200020304	Dry Gulch	74	2.3	0.47	0.00	0.00	0.35	0.00	0.82	1
140100051704	Mid Plateau Ck C	491	3.9	0.67	0.00	0.12	0.00	0.00	0.78	1
140200024902	Little Blue	2,521	33.6	0.43	0.21	0.10	0.01	0.00	0.75	1
140200050901	Petrie Mesa	40	0.1	0.57	0.00	0.14	0.00	0.00	0.71	1
140200054005		7	0.0	0.42	0.00	0.00	0.19	0.00	0.61	1
140200028304	Willow Ck	1,948	25.3	0.34	0.17	0.07	0.03	0.00	0.61	1
140200020306	Dry Ck	171	5.2	0.43	0.14	0.00	0.00	0.00	0.57	1
140200038907	Lower Tomichi C	222	0.8	0.46	0.00	0.00	0.06	0.00	0.52	1
140200051302	Negro Ck	54	1.1	0.51	0.00	0.00	0.00	0.00	0.51	1
140200024903	Pine Ck	120	4.5	0.35	0.14	0.00	0.00	0.00	0.49	1
140200064003	Horsefly Ck	11	0.0	0.47	0.00	0.00	0.00	0.00	0.47	1
140200064807	Lower Cow Ck C	33	0.2	0.46	0.00	0.00	0.00	0.00	0.46	1
140200021001	Spring/Pool Gulches C	13	0.0	0.43	0.00	0.00	0.00	0.00	0.43	1

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Physical Sensitivity

Soil Erosion Risk

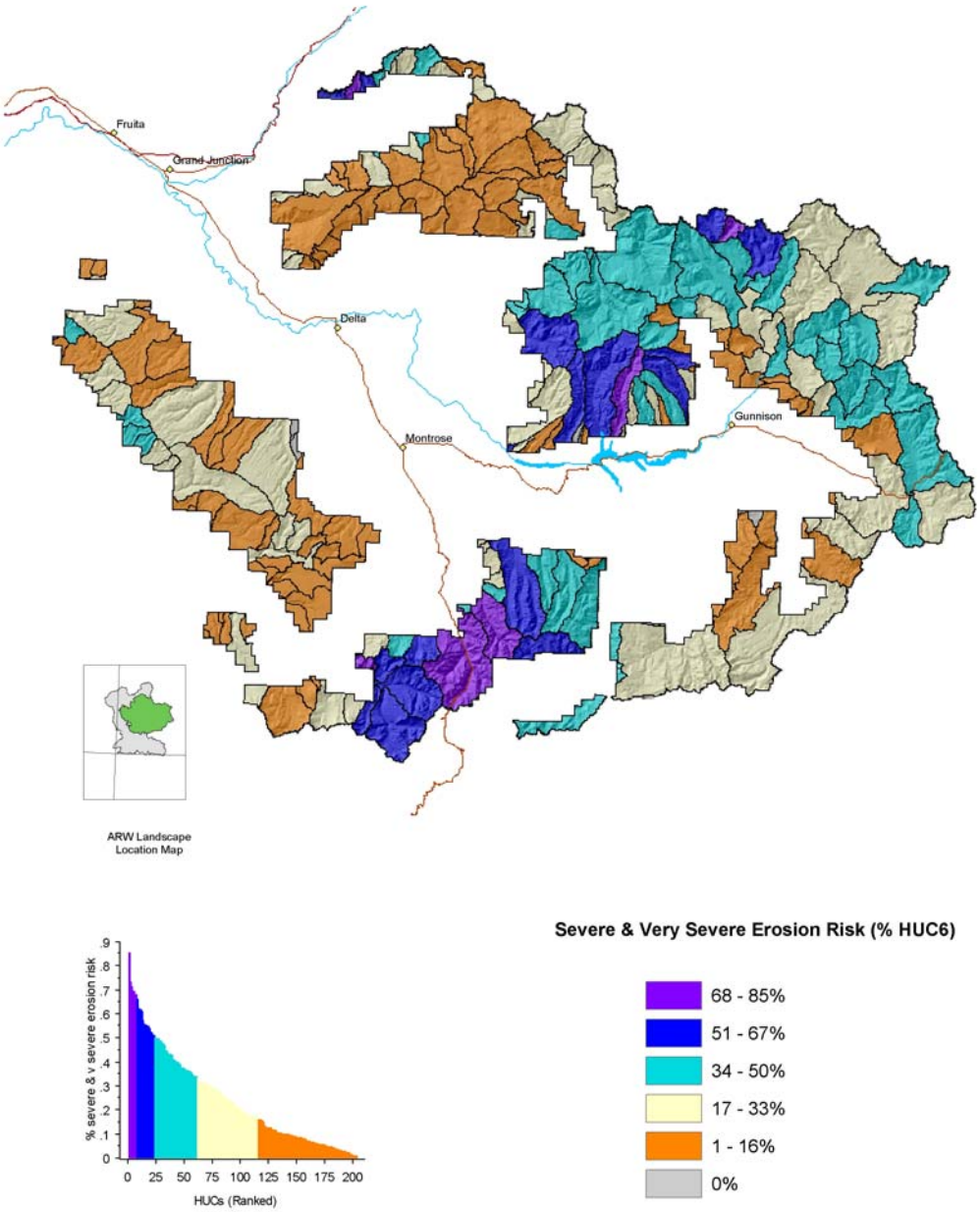
Surface soil conditions greatly influence erosion and sedimentation processes. Potential surface erosion was assessed using available soil survey results in conjunction with slope steepness derived using a 30 meter digital elevation model (dem). Standard erosion risk ratings were assigned as outlined in the NRCS National Forestry Handbook (1998). The ratings (4 classes) represent the risk of soil loss due to sheet and rill erosion after disturbance, and assume surface soil exposure across 50% to 75% of an activity area.

The ratings are based upon the combined affects of the surface soil Kw factor (a relative index of susceptibility determined by physical properties) and the prevailing slope. The soil Kw factor and slope combinations defining the risk classes is included in Appendix D. For this assessment, the combined extent of severe and very severe risk classes as a percentage of the entire sub-watershed area was used to characterize sensitivity to erosion, with larger percentages representing greater sensitivity.

The sub-watershed extent of severe or very severe risk ratings across the GMUG ranges from 0% to 85%. The Forest-wide range of values was divided into 5 equal-sized intervals and a 0.0 class, which are displayed in Figure 5B1-1. A total of 204 sub-watersheds across the GMUG have some percentage of area with severe or very severe risk ratings. The remaining 19 sub-watersheds have no lands rated with severe or very severe erosion risk. Complete tabular results are provided in Appendix B.

The most extensive areas are associated with the steep terrain of the West Elk and San Juan mountain ranges, although notable areas also occur in the Battlements north of Colbran, and the upper East River. Sub-watersheds with 51% or more of their area with severe or very severe erosion risk comprise approximately 15% of the total GMUG land area. By contrast the lowest amounts occur across the subdued terrain of Uncompahgre Plateau and Grand Mesa. The 19 sub-watersheds that contain no severe or very severe erosion risk are limited to the margins of the GMUG.

Figure 5B1-1. Sub-Watershed Extent of Severe & Very Severe Surface Erosion Risk across the GMUG.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Physical Sensitivity

Runoff

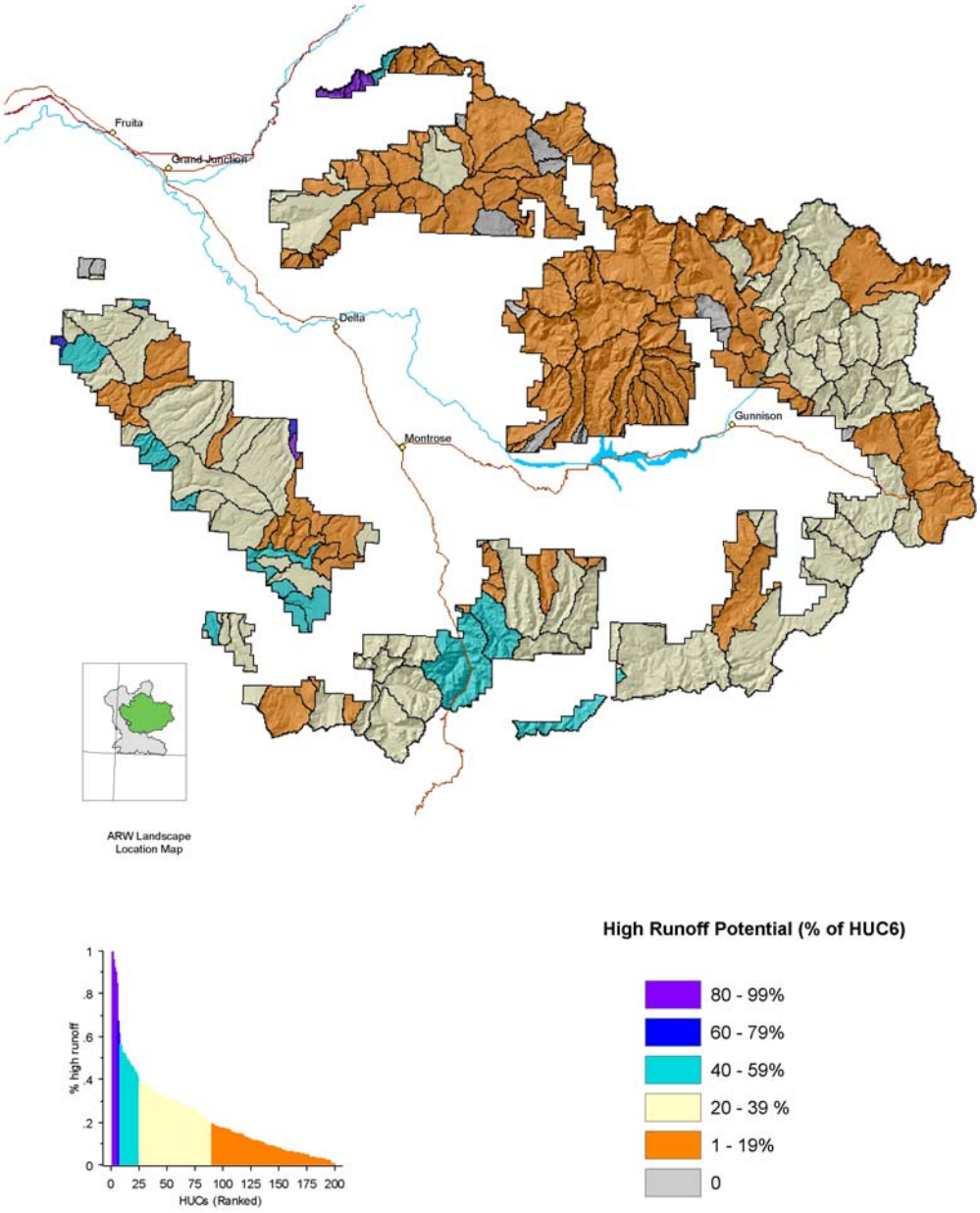
Runoff potential is determined by soil infiltration capacity after prolonged wetting. Soil properties that influence runoff potential include permeability, depth to water table, and depth to a restrictive or impervious layer. Soils across the United States are placed into one of four general runoff or hydrologic groups (A – D). Soils with low runoff potential (hydrologic group A) are generally deep and well drained and have high surface infiltration rates. Soils with high potential runoff (hydrologic group D) are generally shallow or poorly drained or have very slow surface infiltration rates.

Runoff was assessed using hydrologic soil group information available in NRCS soil surveys. The extent of high runoff potential (hydrologic group D) was calculated as a percentage of the entire sub-watershed area, with larger percentages represent greater sensitivity.

The sub-watershed extent of high runoff potential across the GMUG ranges from 1% to 99%. The Forest-wide range of values was divided into 5 equal-sized intervals and a 0.0 class, which are displayed in Figure 5B2-1. A total of 199 sub-watersheds across the forest include some portion in the highest runoff class. The remaining 24 sub-watersheds have no lands rated with high runoff potential. Complete tabular results are provided in Appendix B.

Sub-watersheds with less than 20% of their area in the highest runoff class comprise approximately 50% of the total GMUG land area. In contrast, those sub-watersheds with 60% or more with high runoff potential are limited to less than 1% of the GMUG area. The GMUG portion of those sub-watersheds is dominated by bedrock or thin soils that are shallow to bedrock.

Figure 5B2-1. Sub-Watershed Extent of High Runoff Potential across the GMUG.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Physical Sensitivity

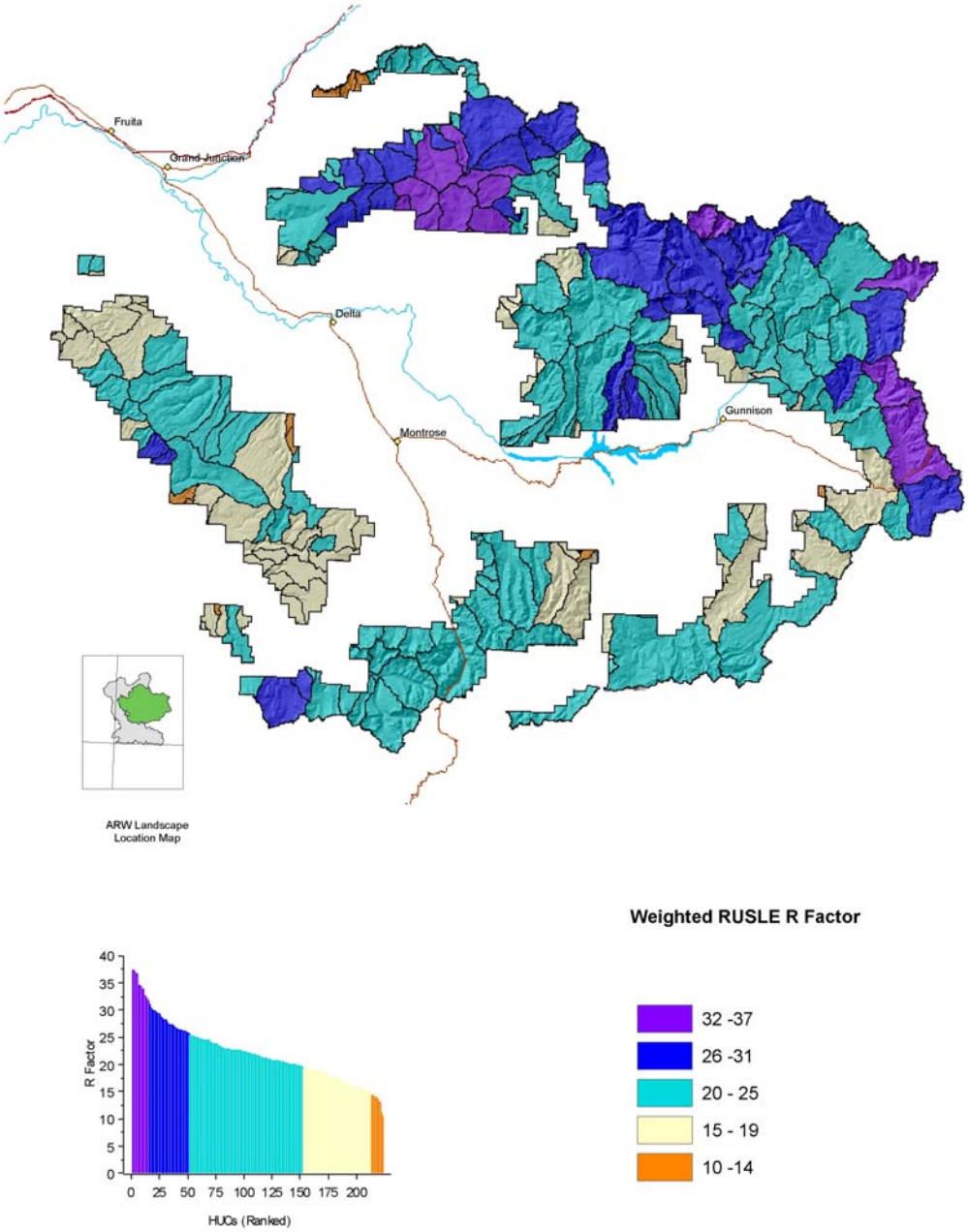
Rainfall Factor

During development of the Universal Soil Loss Equation (USLE) and subsequent Revised Universal Soil Loss Equation (RUSLE) it was determined that when other factors remain constant, soil loss is directly proportional to a rainfall factor related to the total quantity and intensity of rainfall. The RUSLE "R" factor (rainfall erosivity index) is the average annual product of kinetic energy (E) and maximum 30-minute rainfall intensity (I). "R" therefore increases as either the amount or intensity increases. Units are in terms of ft-tons / hour/ acre / year

R factor estimates were determined on a weighted average basis for each sub-watershed. The original 4 km grid of R factors is a provisional version provided by the Spatial Climate Analysis Service at Oregon State University. It is based on climate data for the period 1971 thru 2000. Larger weighted R factors represent greater sensitivity.

The Forest-wide range of "R" factor values was divided into 5 equal-sized intervals, which are displayed in Figure 5B3-1. The highest sub-watershed values occur across the northern and eastern portions of the GMUG. Sub-watersheds in the 2 highest classes (> 25 ft–tons / hr / ac/ yr) comprise approximately 28% of the total GMUG area. The lowest values occur along the boundary of the forest and represent less than 1% of total GMUG area.

Figure 5B3-1. Sub-Watershed Weighted "RUSLE" R Factor across the GMUG.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Physical Sensitivity

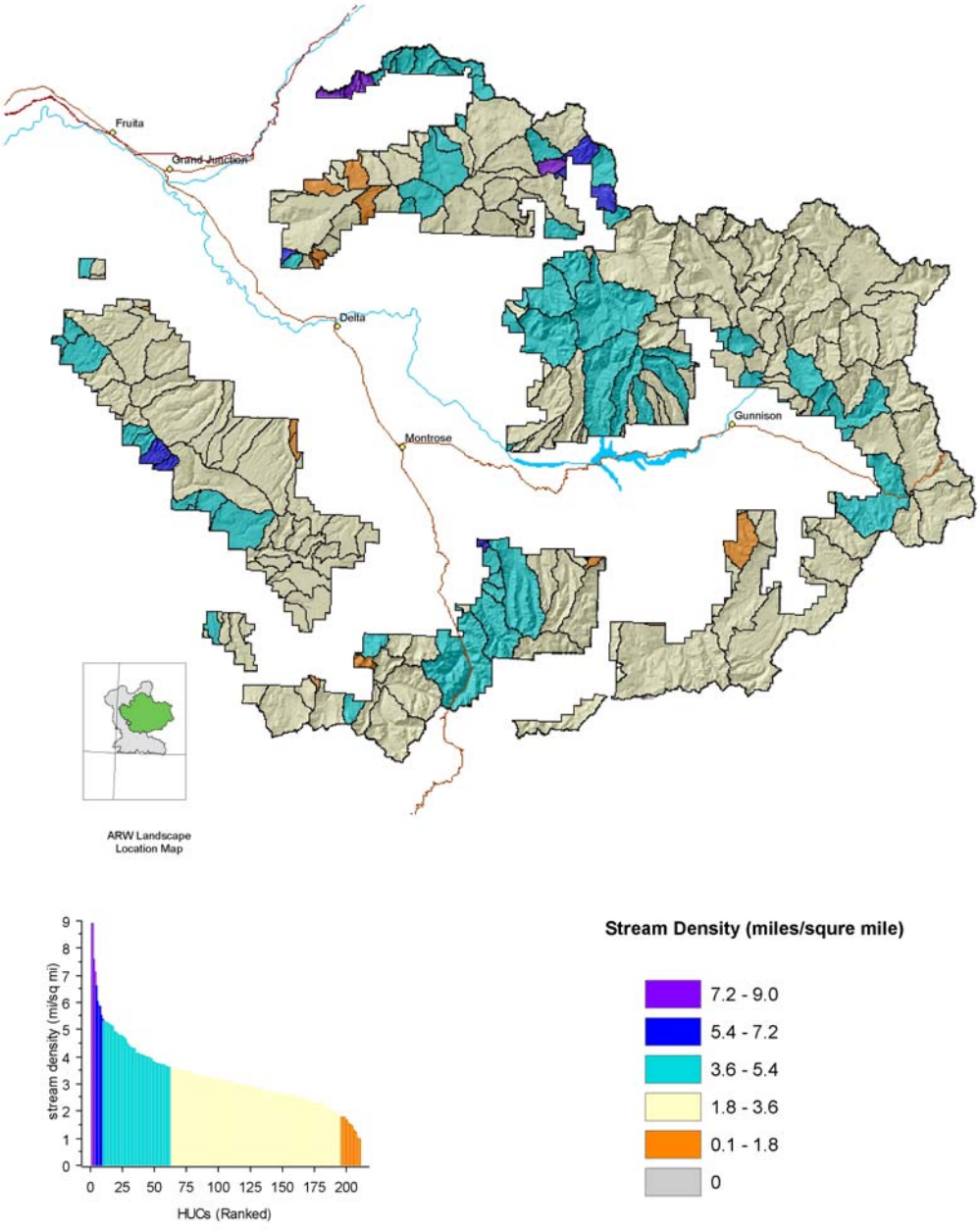
Stream Density

Stream density is expressed in terms of total stream or channel length per unit area (mi/sq mi) and characterizes the degree of landscape dissection and network transport capacity. It measures network texture and the balance between erosive power of overland flow and the resistance of surface soils and rocks. As a result, it reflects the connectivity between hill slopes and the channel system.

High stream densities provide rapid translation of overland flow & sediment production into the channel network and therefore are correlated with faster delivery of water, higher peak flows, and higher sediment delivery. Higher density stream networks are more efficient in the delivery of both runoff and sediment. Larger stream densities represent greater sensitivity.

Stream density across the GMUG ranges from 0 to 8.9 mi / sq mi, with the range of values divided into 5 equal-sized intervals and a 0.0 class, which are displayed in Figure 5B4-1. The vast majority of the GMUG (97 %) have stream densities ranging from 1.8 to 5.4 mi / sq mi. The GMUG portions of sub-watersheds with densities of 0.0 are all less than 500 acres in size with no channels identified on the National Forest.

Figure 5B4-1. Sub-Watershed Stream Density across the GMUG.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Physical Sensitivity

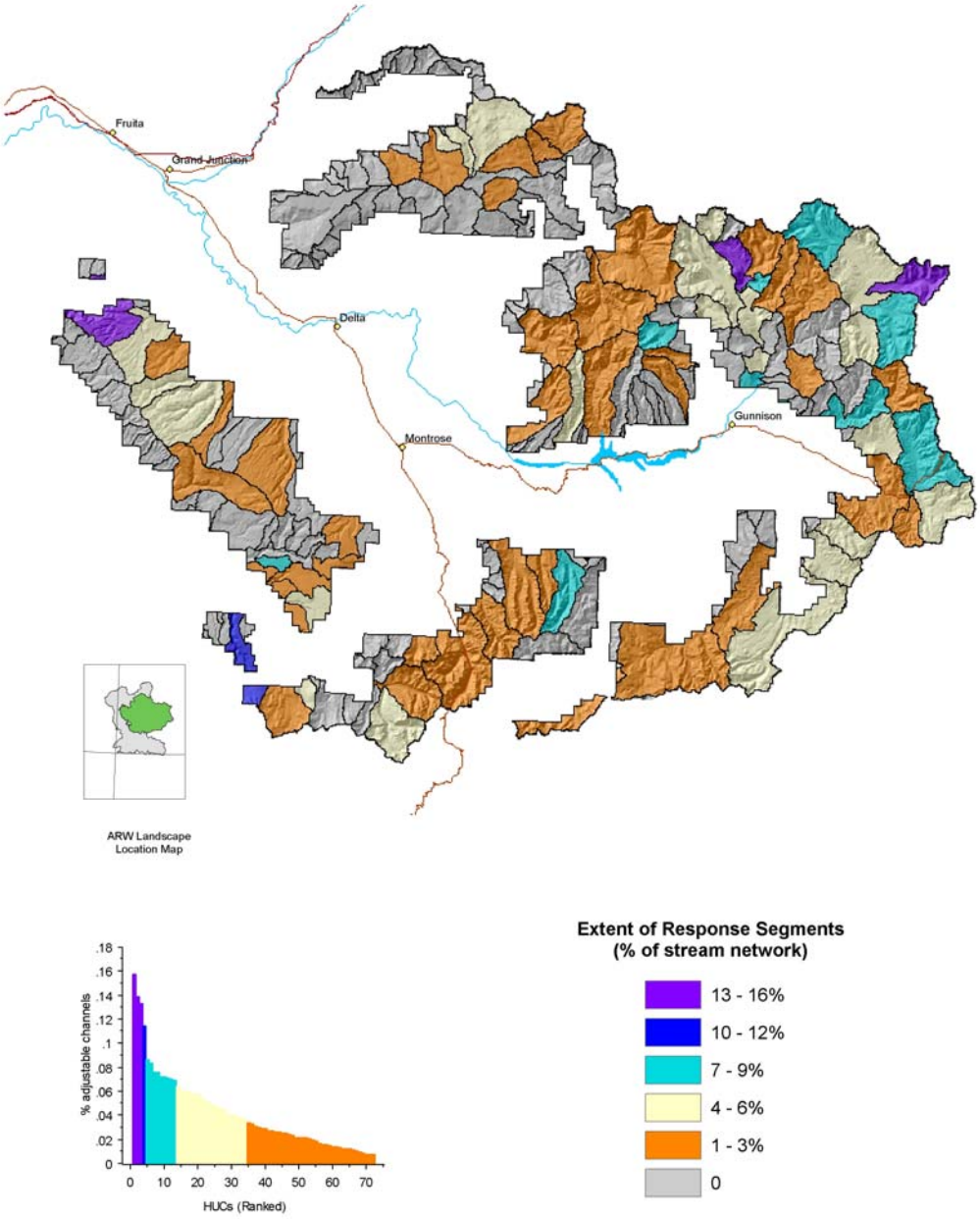
Hydrologic Response Channels

Numerous authors have identified low gradient (<= approx. 2%) unconfined (opportunity for lateral migration) channel segments as sites most likely to respond to changes in flow or sediment regimes. (Montgomery & Buffington, 1993; State of Washington, 1997; Montgomery & MacDonald, 2002; Kershner et al., 2004). Physical responses or changes may occur in any of 3 major stream components: banks, bed, or substrate composition (Kershner et a.l, ibid). Pool-riffle or plane-bed channel are typical channel types found where low gradient unconfined conditions occur, types that provide a diversity of aquatic habitat conditions and normally sustain perennial flow.

Stream networks can be meaningfully simplified (classified) simply based on gradient and confinement (State of Washington, 1997; US Forest Service 1999). Classification and mapping of the entire GMUG stream network into valley segments, similar to a Rosgen Level I inventory (Rosgen, 1996), was completed according to the IRI-CWU procedures. For this assessment, response segments were defined by the following criteria: stream order >=3, with gradient <= 1.5%, alluvial channel material (active floodplain), and a predominance of Rosgen stream types of C, D, or E. The extent of response segments was expressed as a percent of the total stream network, with larger percentages representing greater sensitivity.

The sub-watershed extent of response segments across the GMUG ranges from 0% to 16% of the total stream network, which was divided into 5 equal-sized intervals and a 0.0 class displayed in Figure 5B5-1. A total of 74 sub-watersheds across the GMUG have response segments within their stream networks. Overall those sub-watersheds encompass approximately 68% of the GMUG. The remaining 149 sub-watersheds include no inventoried response segments. Complete tabular results are provided in Appendix B.

Figure 5B5-1. Sub-Watershed extent of Response Segments across the GMUG.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

This assessment addresses land-use activities that have an influence on watershed function, water quality or aquatic habitat and includes both surface disturbance and water development related factors. The activities considered are largely management related, the lone exception being recent wildfire occurrence. The impact or influence of these activities ranges from long term or irreversible (dams, major roads) to shorter term or transient (some canopy treatments, wildfire) that diminishes over time. Some have direct channel or near channel affects (diversions, road-stream crossings) while others are more diffuse occurring across the larger sub-watershed (canopy treatment, road networks) area.

Detailed discussion of the individual variables is presented in subsequent sections 5C2 thru 5C7. Overall or cumulative activity levels were examined in much the same way as sensitivity, discussed in the previous section. However, there are a few notable differences.

The original list of variables (Table 5A-1) includes 3 separate variables affecting natural flow patterns or hydrologic regime (stream miles below diversions, reservoirs or those inundated by reservoirs). For purposes of estimating sub-watershed flow modification, these were combined into a single variable meant to reflect hydrologic regime change. Similarly, 2 variables related to road-stream interactions (buffered riparian motorized route density and motorized route – stream crossing density) are combined into a single standardized 'road-stream' variable.

The single 'combined' variables were used to characterize flow modification and road-stream impacts. This was done in order to avoid weighting overall results had each flow related (3) and stream- road (2) variable been used individually (see also Physical Sensitivity and Management Activities Analysis Steps in section 5.A). Thus, 7 variables (one from each use category in the R2 ARWA protocol) were used to estimate cumulative activity levels.

A key product of the analysis is the classification or categorization of all the sub-watersheds into classes based on cumulative activity levels, to facilitate various interpretations.

Key Findings

- Sub-watersheds in the highest cumulative activity classes (3 and 4) generally have notable (>25% of maximum) levels of multiple activities, rather than a single dominant one.
- Ten (10) sub-watersheds were manually adjusted to the highest relative activity class (4) due to presence of a specific condition indicative of high impact.

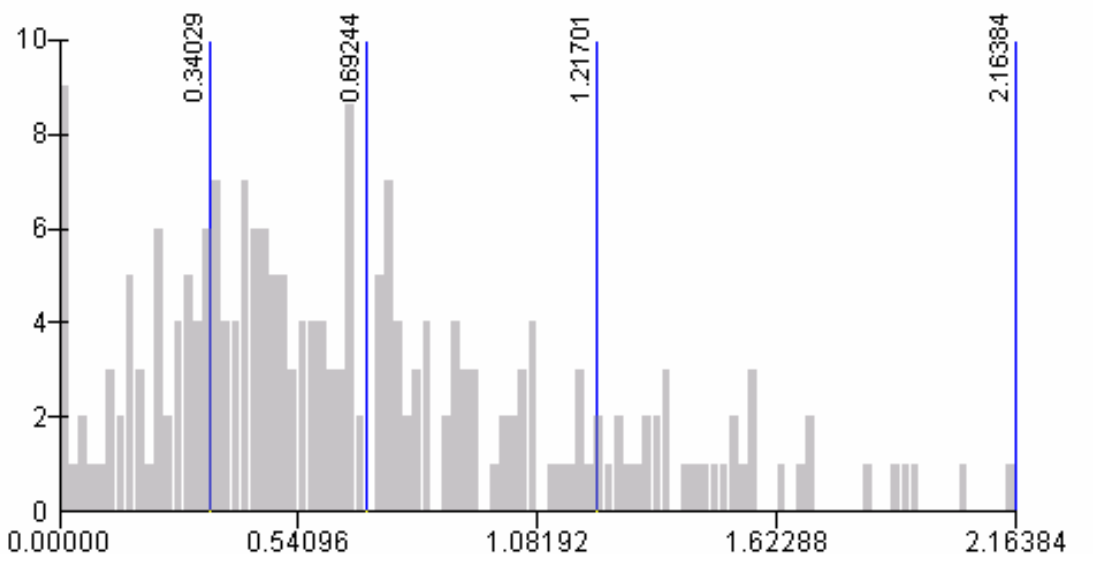
- Roughly 17% of GMUG lands are in the lowest relative activity class (1) and 17% in the highest.
- The seven (7) sub-watersheds with no measurable activities have limited acreages within GMUG boundaries (<2,000 acres).

Results

Theoretically the highest activity total is 7.00, based on the sum of the final 7 standardized activity variables, which range from 0.0 to 1.0. The highest total for the GMUG sub-watersheds is 2.16 (Kizer Ck sub- watershed) while 7 sub-watersheds have totals of 0. The complete distribution of totals is illustrated in Figure 5C1-1 along with the 'Jenk' class or group breaks. Sub-watersheds with totals between 0.00 and 0.34 are placed in Class 1 (least cumulative activities), from 0.35 – 0.69 Class 2, from 0.72 – 1.22 Class 3, and > 1.23 are categorized as Class 4 (most cumulative activities).

This distribution retains the characteristic cluster of observations about a mean typical of a normal distribution. However, it also includes a recognizable tail across the higher cumulative activity levels

Figure 5C1-1. Frequency Distribution of Sub-Watershed Management Activity Totals and Class Breaks.

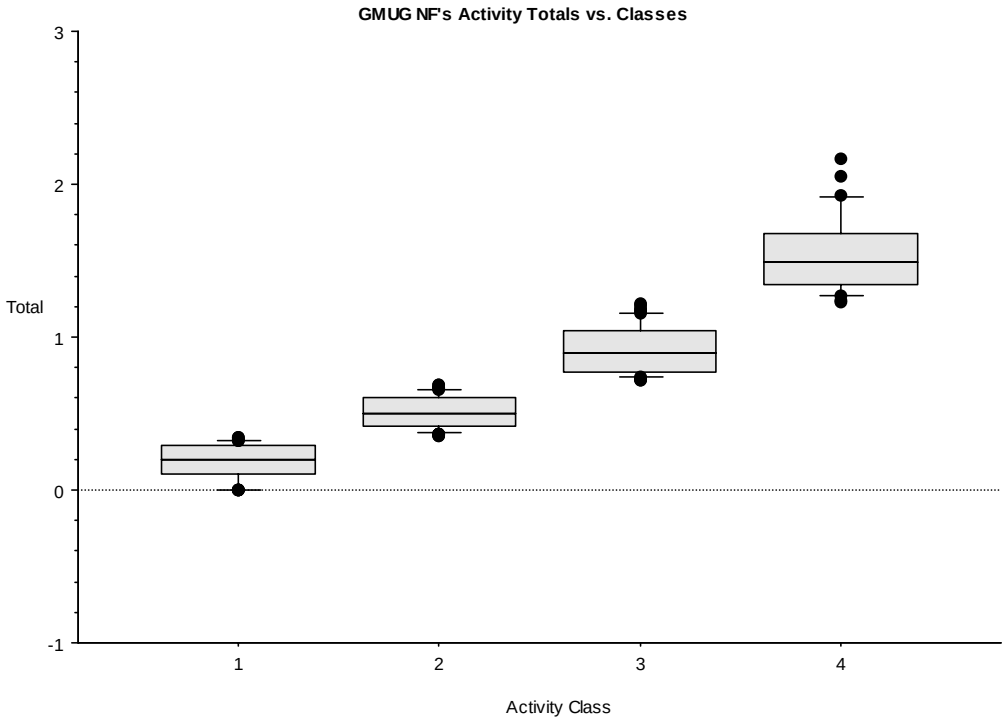


Class 1 Class 2 Class 3 Class 4

The 'box and whisker' diagram of Figure 5C1-2 illustrates the final classification results in a different way, portraying various statistical measures for each class or group. The central bar within each box represents the average totals for all sub-watersheds in the class, the solid boxes include the 25th thru 75th percentiles of scores in the class, the bars beyond the boxes represent the 10th thru 90th percentiles, and finally individual circles are those class members with totals outside the 90th and 10th percentiles.

The ArcGIS Jenk classification again seems to provide good separation between the total activity based groups or classes.

Figure 5C1-2. 'Box and Whisker' diagram of the management activities classification.



During development and interpretation of results, several specific circumstances were identified that if present, reflect a high degree of impact regardless of the derived activity class. Therefore, sub-watershed class assignments are adjusted to the highest class (class 4) where any of the following conditions occur:

1. Presence of a state listed 303d impaired stream segment.
2. Recent wildfire in excess of 25% of the sub-watershed.
3. Water withdrawal is 20% or more of natural yield and 10% more of the stream network lies below diversion structures.

Table 5C1-1 lists the 17 sub-watersheds meeting one of the criteria (none met 2 or more). Of those, 7 were placed in the highest activity level group during the initial classification. Most adjustments were due to the extent of active water withdrawals occurring.

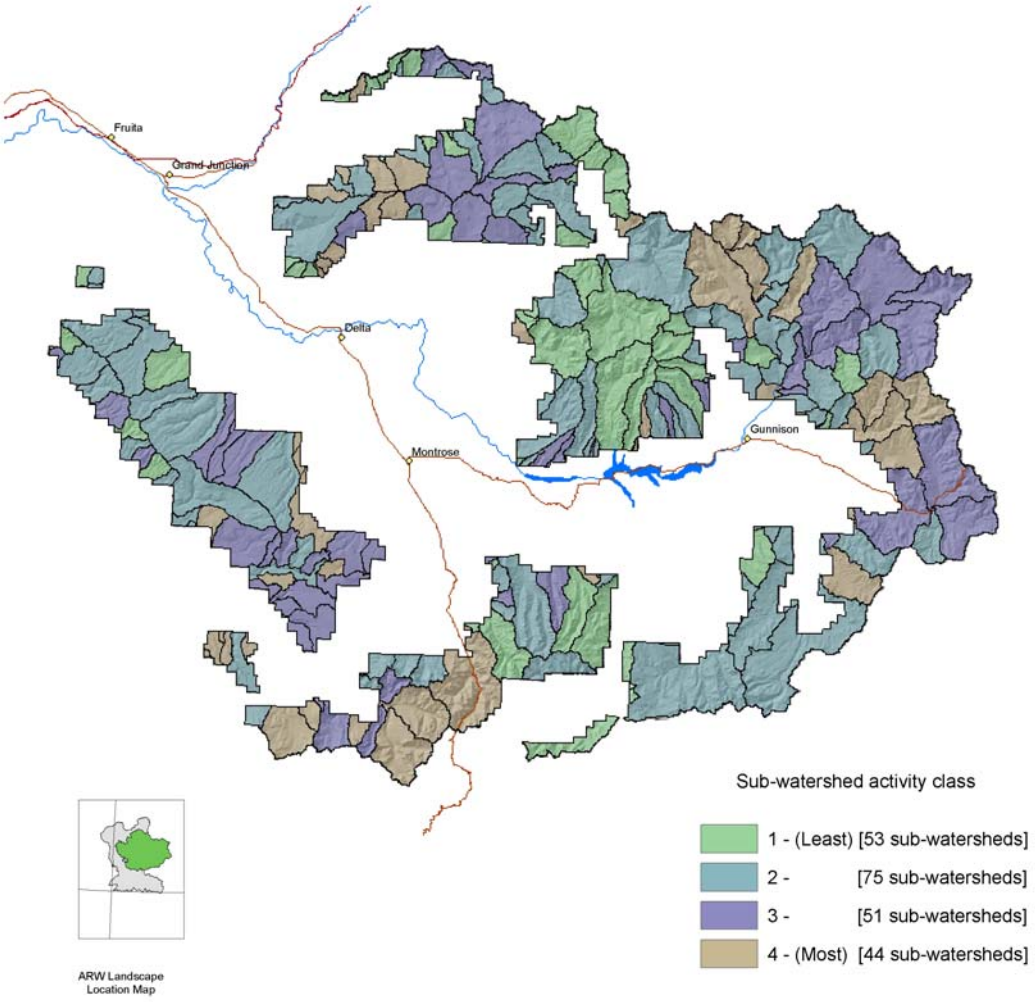
Table 5C1-1. Sub-watersheds with Presence of High Impact Condition.

Criteria & Sub-Watershed Observed	Initial Class	Adjusted Class
303d stream segments:		
Slate Rvr	4	4
Upper Uncompahgre Rvr	4	4
Upper San Miguel Rvr C	4	4
> 25% recent wildfire:		
Bucktail Cks C	3	4
McKee Draw	4	4
Burn Canyon	4	4
Callan Draw	3	4
Hamilton Ck	4	4
Albin Draw	3	4
>= 10% network affected and >= 20% withdrawal:		
Anderson Gulch	1	4
Spring Ck	2	4
Paonia Reservoir C	1	4
Cottonwood C	2	4
Dry Gulch	3	4
Beaver Ck	3	4
South Fk San Miguel Rvr	4	4
Bear Ck	3	4

The forest-wide results following the adjustment are displayed in Figure 5C1-3. Approximately 17% of the GMUG is in Class 1, 40% is Class 2, 25% in Class 3, and 17% in Class 4. Complete tabular results are provided in Appendix C.

Several patterns are evident in the forest-wide results. Highest cumulative activity classes (3 and 4) occur in several clusters across the forest. The higher classes on the Grand Mesa are largely due to hydrologic regime affects and or streamside recreational use. The upper East River area reflects the presence of mining and streamside recreational use. Higher levels of motorized routes and streamside recreational use are notable in the Taylor River, Quartz Creek, and Tomichi Creek areas. The upper San Miguel and Uncompahgre Rivers largely reflect the influence of mining and extensive private ownership. The southern Uncompahgre Plateau reflects motorized route and canopy treatment affects.

Figure 5C1-3. GMUG Sub-Watershed Activity Classes.



Sub-watersheds with greater than 50% of the GMUG area within designated Wilderness are generally in Classes 1 and 2. The exceptions being Bilk and Deep Creeks in the Upper San Miguel, Copper Creek in the East River, and Texas Creek in the Taylor River watersheds.

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

Water Use

Key Findings

1. Many of the stream diversions are located within a mile or less of the Forest boundary and effect a relatively small percentage of the stream miles network.
2. Most of the storage facilities are located in the upper reaches of the watershed and affect a relatively larger percentage of the stream network.
3. Streams on the National Forest are often hydrologically disconnected from adjacent watersheds due to effects of water development below the National Forest.
4. The effects of stream diversion depletions are concentrated primarily during base flow summer and early fall periods. Winter base flows and spring peaks are relatively unaffected.
5. Drought conditions can exasperate the effects of stream flow depletions.
6. Over the last 100 years, ditch breeches and hillslope failures, due to saturation, have caused significant erosion problems and resulted in large sediment delivery events to valley bottoms and channels.
7. Aquatic diversity and productivity impacts, along with changes to channel morphology have not been quantified for specific diversions. Separating natural variability and disturbance from affects of human actions is difficult to determine with certainty. The degree to which diversions on streams are having an effect is highly variable. Those effects are not always recognizable; in some cases probably exaggerated and in all cases difficult to quantify.

Influences of Water Developments (Reservoirs and Stream Diversions)

The effects of reservoirs tend to be much different than stream diversions. One must be careful on generalization of effects. However, on-channel storage facilities tend to store water during the winter and spring period and thus impact aquatic systems by reducing winter flows and eliminating hydrologic peaks. Storage projects capture sediment and organics and thus eliminate their contribution to streams and floodplains below the facility. Water is often released into natural channels for delivery downstream and therefore an increase above natural flows can occur during the summer and fall periods, which can increase productivity for some species, i.e., Taylor River below the reservoir is

a trophy fishery in part due to reservoir management operations. However, since many native species evolved in an environment where large fluxes in flow would occur throughout the year, they are often at a competitive disadvantage to some non-native species, which thrive in an altered environment.

Diversions can de-water stream segments and/or augment flows associated with trans-watershed diversions. On the GMUG many water transmission systems rely on natural channels to transport water. Flow in these channels may be augmented by water transferred from one or more nearby watersheds and routed down the channel.

A complete description of the influence of water storage projects and diversions on aquatic, riparian and wetland ecosystems is provided in Winters et al. 2003, vers. 1.0).

The following direct effects are either known to exist or may occur in association with water development and use activities on the GMUG.

Hydrology

- Short and long term changes in the quantity and timing of stream discharge.

Water Quality

- Modification in nutrient and sediment transfer downstream.
- Increased erosion associated with structures.
- Increased erosion from modification of flow regime downstream.
- Decreased dilution potential of point and non-point source pollutants.
- Increases in water temperature and reduction in dissolved oxygen associated with reduced flows.

Wetlands and riparian areas

- Changes in riparian plant species health and composition due to changes in soil moisture.
- Reduction in species recruitment that require disturbance and/or deposition of sediments on the floodplain.
- Inundation and loss of wetland features from water storage facilities.
- Increases in wetlands as a result of ditch seepage or along the margins of water storage projects or at locations where old ponds have silted in.

Uplands

- Catastrophic failure of water transmission facilities has caused significant hill slope erosion and slope failure. Sediment and debris has been delivered to valley bottoms and in some cases directly to channels.

Channel conditions

- Lack of channel forming flows or reduced frequency of flows can result in channel "narrowing" in depositional, low gradient reaches. [Note: there is no data to suggest this has or has not occurred on the Forest. However, if it has occurred it would be most likely to exist below reservoirs that rely on spring runoff]
- Bank instability and channel scour if storage releases or trans-watershed diversions are not in balance with channel morphology
- Loss of macro-invertebrate and spawning habitat caused by sediment deposition from both upstream erosion or lack of sediment transport flows.

Biotic Conditions

- Inability for stream organisms to migrate up and downstream past barriers (structures and/or dewatered reaches), or move between basins.
- Competition between native and non-native fish species as conditions change in the stream.
- Entrainment of fish and other aquatic biota into ditches.
- Increased potential for disease as water quality and flow regimes change.

Landscape Scale

Water originating within the GMUG is tributary to the Colorado River system, and flows into one of three Basins. Seventy five percent (75%) of the Forest lies within the Gunnison River Basin, which joins the Colorado River at Grand Junction, Colorado. Fifteen percent (15%) is tributary to the San Miguel/Dolores Basin, which joins the Colorado River's in Utah. Ten percent (10%) is tributary to Plateau Creek, which joins the Colorado River upstream from Grand Junction. There is only one known diversion that takes water out of the Upper Gunnison, which is tributary to the Colorado River, and delivers it into the Rio Grande River Basin.

The effects of water facility structures and changes in flow regimes may act as independent effects, but more likely act cumulatively with other factors such as introduction of non-native species, the result being profound changes in aquatic ecosystems over the last 100 years. These effects are projected based upon reasonable assumptions and course filter evidence. Verification of effects can only be accomplished by examination of field indicators at a reach or habitat unit scale.

Management Scale

Forest-wide Summary

It has been acknowledged that definitive impacts of individual diversions is not well understood across the Forest, however in combination with off-Forest developments the ***cumulative effects of water development activities has had as much or more influence***

on the status of present aquatic, riparian and wetland ecosystems and dependant species as any other human activity. Water development first occurred in conjunction with precious metals mining around Ouray, Telluride, Lake City and Pitkin. Permanent settlements in the valleys surrounding what is now the GMUG resulted in a growing agricultural demand for water. Many of the early agricultural water rights originated in the 1880s. Effects are not uniformly distributed throughout the Forest and in fact watersheds within the National Forest are much less affected than private lands below the boundary. Not all watersheds have been impacted by water development. However, in areas such as the Grand Mesa, there may not be a single drainage unaffected by changes to flow regimes as a result of storage, diversion depletions or augmentation. Irrigation of agricultural lands is still the most significant use of water developed on the Forest. However, over time municipal and industrial uses are expected to increase, which have a greater potential for effects throughout the year, versus the typically seasonal nature of agricultural demands. Table 5C2-1 broadly summarizes the downstream affects of water developments Forest-wide.

Watershed Scale Summary

Risks associated with water developments were evaluated by determining the proportion of the blue line stream network affected by diversions and reservoirs. The blue line network is considered the perennial and intermittent stream segments from the Cartographic Feature File (CFF) based GIS coverage.

Direct channel influence measures:

- Stream Miles below Diversions (% of blue line network).
- Stream Miles below Reservoirs (% of blue line network).

Floodplain and riparian area/wetland influence measure:

- Stream Miles Inundated by Reservoirs (% of blue line network)

Data limitation and display

Diversion affects are based on the total length of perennial or intermittent stream below a diversion to the forest boundary, or to a confluence of equal or greater stream order. The assumption is that impacts would be mitigated by the contribution of flow at the confluence. This is a reasonable assumption in doing a broad scale assessment, however in reality there will be cases where this assumption is not valid and the length of stream affected is more or less than estimated. Active diversion points, current to year 2001, were provided by the State of Colorado Division Engineer's Office in a GIS coverage. The miles of stream affected does not reflect multiple diversions on the same stream. The stream segments identified are displayed in Figure 5C2-1.

There are significant gaps in our understanding of the specific effects of diversions on aquatic systems. The most significant variable is knowledge of how the diversion is

operated, how much water is diverted, for how long and how often, all key in linking to the health of downstream reaches. The Colorado Division Engineers Office maintains records on diversion operations, but those records are limited to major diversions.

Reservoir affects are based upon the proportion of the blue line network below as well as inundated by significant impoundments. Only reservoirs of 50 acres surface acres and larger were examined based on the premise that significance is reached at 50 acres. At that scale projects would be impacting entire stream reaches or major wetland complexes. There are many smaller reservoirs whose affects are not addressed. The smaller reservoirs have limited capability to influence flow regimes, although they would have just as great of an affect on species migration as the larger facilities.

A total of 20 reservoirs met the 50-acre criteria. Although the total number of impoundments is unknown, it probably exceeds a thousand if stock ponds are counted. The reservoirs and downstream network identified are displayed in Figure 5C2-2.

The acreage of wetland and/or spring associated habitat that has been lost or gained by water storage/detention was not addressed in this report.

Small impoundments that were constructed on wetlands or springs have had important impacts on habitat and water dependant species even though the area is quite small. Converting a spring and associated wetland feature to a pond has likely had detrimental effects on amphibians and some plant species. Ponds that catch seasonal runoff tend to have a lesser effect to wetlands, but since they are typically an in channel structure they are prone to filling with sediment and/or breaching over time. Breaches have the potential to initiate channel incision with the effects migrating head-ward and causing riparian degradation to expand. Given our analysis the cumulative affects of this activity are significantly under-estimated.

Direct channel influences

Stream Miles Below Diversions

Evaluating the percentage of blue line stream network that has been impacted by diversions and storage projects at the 6th HUC sub-watershed scale provides the means for interpreting one aspect of potential effects on aquatic and riparian resources. Of the 223 6th sub-HUC watersheds examined, 102 watersheds are affected by one or more diversions. Forest-wide results are displayed in Figure 5C2-3.

During the years 2000 thru 2002 an inventory of stream diversion headgates was conducted at 230 locations. While this inventory was not associated with the species conservation assessment, the data collected does contribute to our knowledge on effects of diversions. These inventories were intended to document general characteristics of the diversion and associated stream, but were not designed to either qualify or quantify effects. These characteristics can be interpreted relative to channel disturbance, to species movement and dewatering.

Both the percentage of stream network affected, as well as the total miles of stream affected were examined. Looking at both attributes will help adjust for scale, Tables

5C2-2 and 5C2-3 demonstrate that total miles affected is often independent of the percentage of the network affected. Upper Tomichi Creek has 20.1 miles of stream affected, or 10% of the total stream network. This is the greatest affected stream mileage of all the sub-watersheds. The Upper San Miguel composite sub-watershed has the greatest combination of affected stream miles (12.5) and percentage of network (17.1%).

We have identified 39 6th HUC sub-watersheds that are greater than 10,000 acres in size that have no miles of stream affected by diversions.

Stream Miles Below Reservoirs

Of the 12 sub-watersheds affected by reservoirs with a surface area greater than 50 acres, all but two are associated with the Grand Mesa. Complete forest-wide results are provided in Figure 5C2-4 and Tables 5C2-4 and 5C2-5. The Lower Taylor River below Taylor Park Reservoir has the greatest mileage affected. The Taylor Park Dam has blocked migration of species, but all things considered there are a number of benefits to the way water and stream flows are managed. The regulation of flows have enhanced the recreational fishery and also allowed for rafting throughout the summer months.

Floodplain and riparian area/wetland influences

Stream Miles inundated by Reservoirs

Forest-wide, 11 sub-watersheds have had near stream riparian ares and wetlands inundated by construction of reservoirs with surface areas > 50 acres. Taylor Park Reservoir has inundated the largest amount of the stream network in both absolute and relative terms (Table 5C2-6). The relative sub-watershed affects are also illustrated in Figure 5C2-5.

Table 5C2-1. Downstream Affects on Streams and Sub-Watersheds by Water Developments on the GMUG NFs.

Stream and Sub-watershed	**Total on GMUG**	**Affected by Diversion**	**Affected by Reservoirs**
Perennial (mi)	3,509	336	93
Intermittent (mi)	6760	87	<1
6th HUC Basin (number)	223	102	12

Figure 5C2-1. Forest-wide Stream Segments below Diversions.

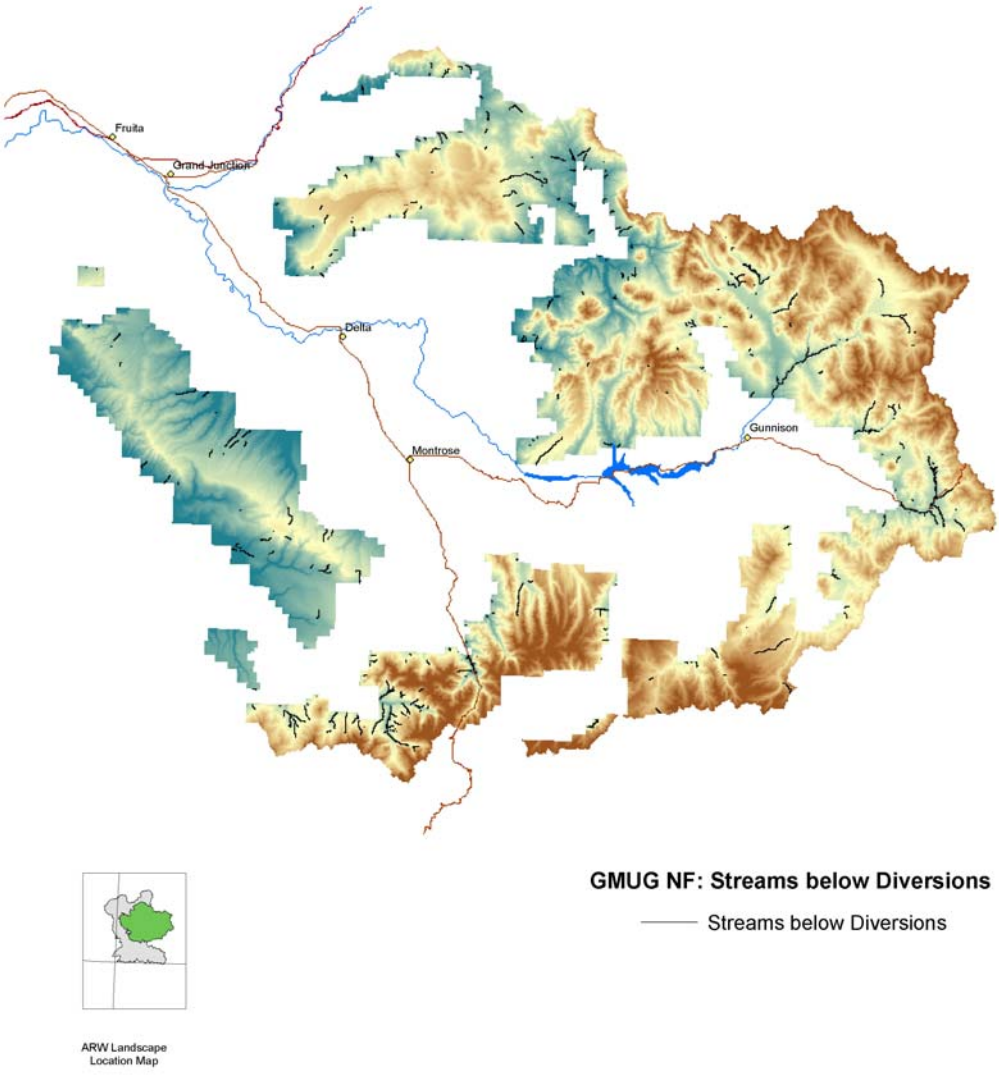


Figure 5C2-2. Forest-wide Reservoirs >= 50 Surface Acres and Stream Segments below them.

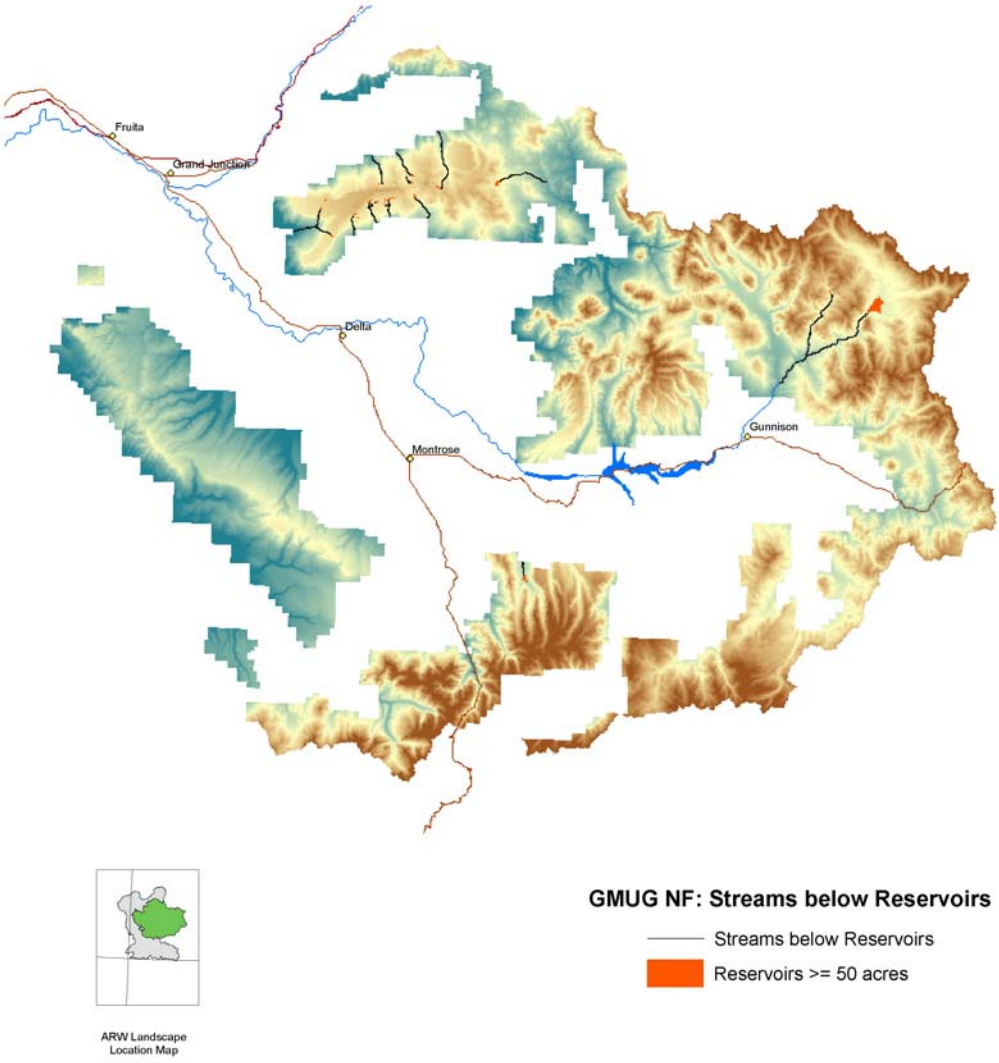


Figure 5C2-3. Proportion of Blue Line Stream Network below Diversions.

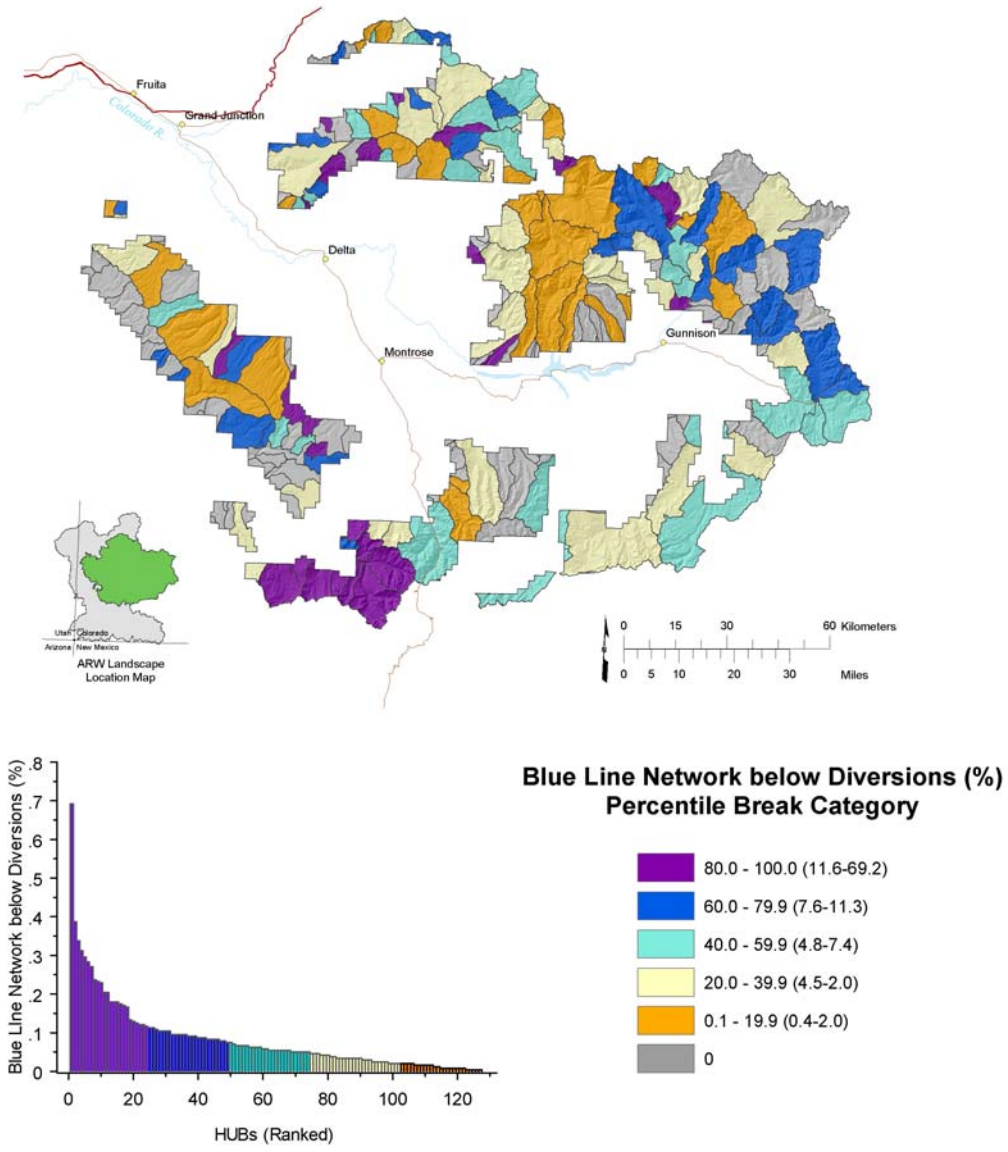


Table 5C2-2. Stream Miles below Diversions (% of blue line network), 102 HUC6s > 0.0, Highest 20%

WATERSHED NAME	HUC6 ID	SUB-WATERSHED NAME	% of network	% NF	NF Acres	% Wild
Tongue/Currant Cks C	**140200051301**	**Dry Gulch**	**69.2**	**16**	**1,011**	
Crystal/Curecanti Cks C	140200025303	Mesa Ck	38.6	84	7,126	
Plateau Ck	140100051714	Spring Ck	33.9	29	2,532	
Upper San Miguel Rvr	140300036305	Deep Ck	31.3	100	9,079	56
Beaver/Mckenzie Cks C	**140300034703**	**Specie Ck**	**29.7**	**14**	**1,044**	
Upper San Miguel Rvr	140300036307	Bear Ck	28.4	62	6,431	29
Upper San Miguel Rvr	140300036306	Bilk Ck	27.2	89	8,095	58
West Muddy Ck	140200045503	Cow Ck	23.8	100	11,599	
Horsefly Ck	140300036506	Clear Ck	23.3	100	5,094	
Beaver/Mckenzie Cks C	140300034702	Saltado Ck	23.1	48	6,271	4
Upper San Miguel Rvr	140300036304	South Fk San Miguel Rvr	20.2	100	37,144	14
Upper San Miguel Rvr	140300036308	Fall Ck	20.2	65	17,232	40
Leroux/Cottonwood Cks C	140200045807	Cottonwood Ck	18.1	32	4,882	
East Rvr	140200019907	Mid East Rvr C	18.0	96	15,769	9
Beaver/Mckenzie Cks C	140300034701	Beaver Ck	17.9	59	28,561	5
Tongue/Currant Cks C	140200051305	Dirty George Ck	17.7	58	9,698	
Upper San Miguel Rvr	140300036303	Upper San Miguel Rvr C	17.1	100	32,669	4
Roubideau Ck	140200057703	Cottonwood Ck	16.5	46	9,613	
Tongue/Currant Cks C	140200051307	Kiser Ck	13.3	41	8,884	
Gunnison Rvr C	140200025401	Gunnison Rvr C	12.8	27	5,632	
North Fk Gunnison Rvr C	140200041104	Paonia Reservoir C	12.7	38	5,846	49
Plateau Ck	**140100051708**	**Salt Ck**	**12.2**	**19**	**2,358**	
Upper San Miguel Rvr	140300036302	Leopard Ck	11.9	36	7,507	46
Dry Ck	140200065001	East Fk Dry Ck	11.6	47	16,385	0
Upper San Miguel Rvr	**140300036301**	**Mid San Miguel Rvr C**	**11.3**	**17**	**3,636**	**0**
Plateau Ck	140100051702	Anderson Gulch	11.1	42	3,656	

Bold text indicates basins with less than 25% National Forest.

Table 5C2-3. Sub-Watersheds with at least 5 stream miles below diversions

WATERSHED NAME	HUC6	SUB-WATERSHED NAME	mi below diversion
Upper Tomichi Ck	140200039103	Upper Tomichi Ck	20.1
Upper San Miguel Rvr	140300036304	South Fk San Miguel Rvr	16.6
Upper San Miguel Rvr	140300036303	Upper San Miguel Rvr C	12.5
Taylor Rvr	140200019501	Lower Taylor Rvr C	12.3
Beaver/Mckenzie Cks C	140300034701	Beaver Ck	12.2
Cochetopa Ck	140200038701	Upper Cochetopa Ck	11.6
Taylor Rvr	140200019507	Willow Ck	10.2
East Rvr	140200019908	Slate Rvr	9.8
Lower Tomichi Ck C	140200038901	Mid Tomichi Ck C	9.4
Quartz Ck	140200039301	Lower Quartz Ck C	9.3
Upper Uncompahgre Rvr	140200067901	Upper Uncompahgre Rvr	9.2
East Rvr	140200019907	Mid East Rvr C	9.2
Upper Tomichi Ck	140200039102	Marshall Ck	9.2
West Muddy Ck	140200045503	Cow Ck	8.6
Coal/Cottonwood Cks C	140300034501	Cottonwood Ck	7.5
Upper San Miguel Rvr	140300036308	Fall Ck	7.5
Cimarron Rvr	140200028101	Cimarron Rvr	7.3
East Rvr	140200019904	Cement Ck	7.0
Buzzard Ck	140100051906	Upper Buzzard Ck	6.8
Cebolla Ck	140200028502	Upper Cebolla Ck	6.7
Crystal/Curecanti Cks C	140200025303	Mesa Ck	6.3
Lake Fk Gunnison Rvr	140200028301	Lower Lake Fk C	6.3
Upper San Miguel Rvr	140300036306	Bilk Ck	5.7
Upper San Miguel Rvr	140300036305	Deep Ck	5.6
Quartz Ck	140200039303	Gold Ck	5.5
Upper San Miguel Rvr	140300036307	Bear Ck	5.0

Figure 5C2-4. Proportion of Blue Line Stream Network below Reservoirs.

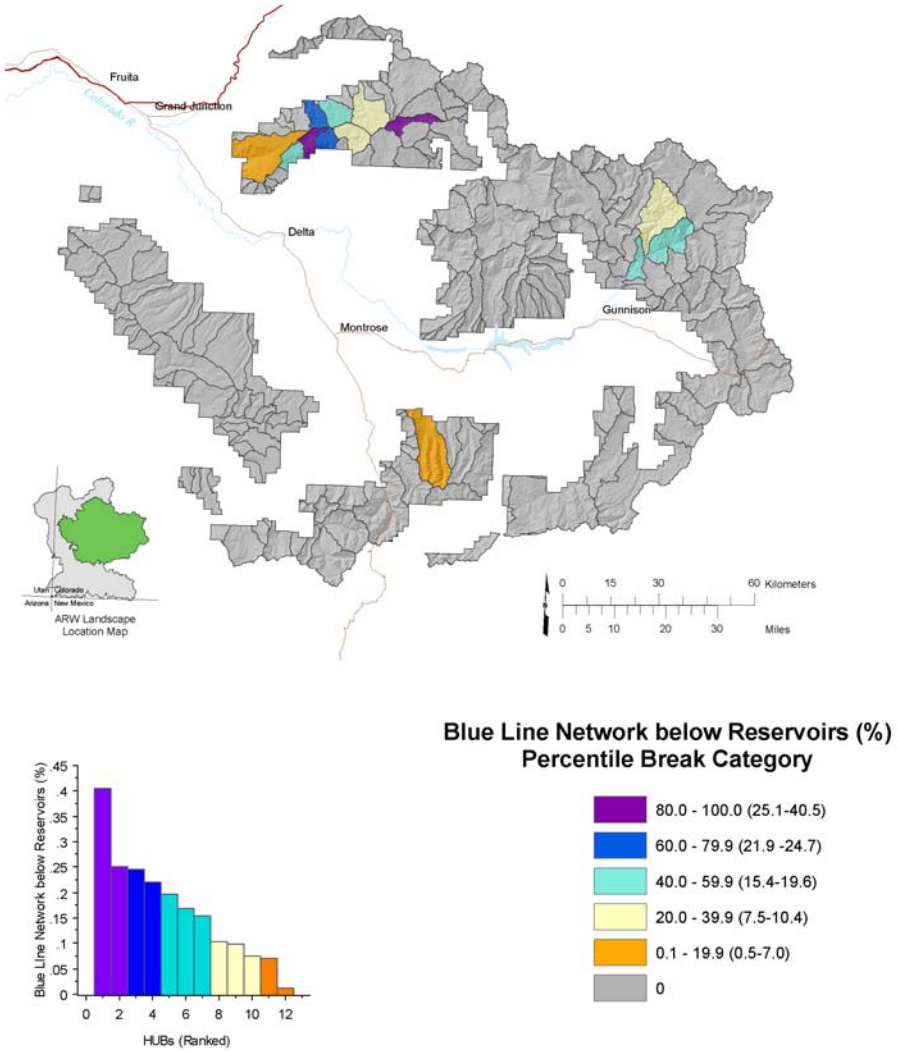


Table 5C2-4. Stream Miles below Reservoirs (% of blue line network)

WATERSHED NAME	HUC6 ID	SUB-WATERSHED NAME	% of total network	% NF	NF Acres
Tongue/Currant Cks C	140200051306	Ward Ck	40.5	71	9,076
West Muddy Ck	140200045503	Cow Ck	25.1	100	11,599
Plateau Ck	140100051712	Cottonwood Ck	24.7	76	10,679
Tongue/Currant Cks C	140200051307	Kiser Ck	21.9	41	8,884
Tongue/Currant Cks C	140200051305	Dirty George Ck	19.6	58	9,698
Plateau Ck	140100051710	Big Ck	17.0	93	15,468
Taylor Rvr	140200019501	Lower Taylor Rvr C	15.7	98	38,325
Taylor Rvr	140200019505	Spring Ck	10.4	100	43,940
Plateau Ck	140100051707	Leon Ck	9.9	96	27,684
Tongue/Currant Cks C	140200051309	Surface Ck	7.5	69	16,757
Kannah/Whitewater Cks C	140200051501	Kannah Ck	7.0	57	49,460
Cimarron Rvr	140200028101	Cimarron Rvr	1.2	56	46,322

Table 5C2-5. Stream Miles below Reservoirs (total miles)

WATERSHED NAME	HUC6	SUB-WATERSHED NAME	mi
Taylor Rvr	140200019501	Lower Taylor Rvr C	20.2
Taylor Rvr	140200019505	Spring Ck	12.2
Plateau Ck	140100051707	Leon Ck	10.8
Kannah/Whitewater Cks C	140200051501	Kannah Ck	9.7
West Muddy Ck	140200045503	Cow Ck	9.0
Plateau Ck	140100051710	Big Ck	6.8
Plateau Ck	140100051712	Cottonwood Ck	5.2
Tongue/Currant Cks C	140200051306	Ward Ck	5.2
Tongue/Currant Cks C	140200051309	Surface Ck	4.5
Tongue/Currant Cks C	140200051307	Kiser Ck	4.0
Tongue/Currant Cks C	140200051305	Dirty George Ck	3.3
Cimarron Rvr	140200028101	Cimarron Rvr	2.3

Figure 5C2-5. Proportion of Blue Line Stream Network below Reservoirs.

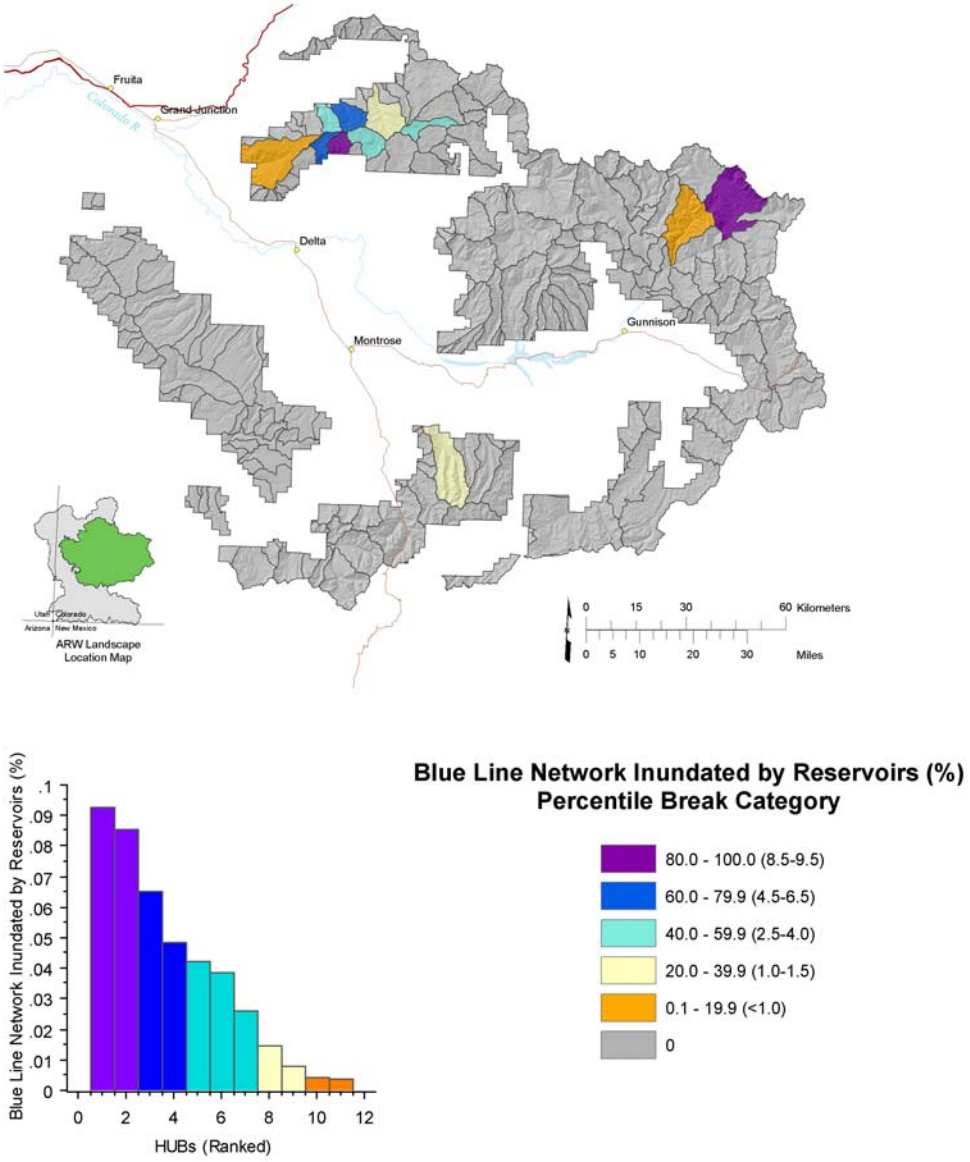


Table 5C2-6. Stream Miles Inundated by Reservoirs (% of blue line network)

WATERSHED NAME	HUC6 id	SUB-WATERSHED NAME	Total Inundated mi	% of network mi	% NF	NF Acres
Taylor Rvr	140200019506	Mid Taylor Rvr C	15.3	9.3	100	56,061
Tongue/Currant Cks C	140200051307	Kiser Ck	1.5	8.6	41	8,884
Plateau Ck	140100051710	Big Ck	2.6	6.5	93	15,468
Tongue/Currant Cks C	140200051306	Ward Ck	.6	4.8	71	9,076
Plateau Ck	140100051712	Cottonwood Ck	.9	4.2	76	10,679
West Muddy Ck	140200045503	Cow Ck	1.4	3.9	100	11,599
Tongue/Currant Cks C	140200051309	Surface Ck	1.6	2.6	69	16,757
Cimarron Rvr	140200028101	Cimarron Rvr	2.7	1.5	56	46,322
Plateau Ck	140100051707	Leon Ck	.9	0.8	96	27,684
Taylor Rvr	140200019505	Spring Ck	.5	0.4	100	43,940
Kannah/Whitewater Cks C	140200051501	Kannah Ck	.5	0.4	57	49,460

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

Transportation

Key Findings

1. Motorized route (roads and motorized trails) influence was examined using three different measures of potential influence to aquatic resources: sub-watershed, floodplain and riparian, and direct channel influences.

2. There are 5,714 miles of motorized routes (4,882 miles of roads and 832 miles of motorized trails) on the GMUG. The vast majority of the roads (approximately 60 percent) are in maintenance levels 1-3, which are generally native surface roads that are minimally maintained.

3. Road densities range from no documented system roads in 14 6th level sub-watersheds to a high of 9.2 mi/mi2 in the East Creek sub-watershed. Forty-two sub-watersheds are in the highest percentile (80-100) break category, having motorized route densities ranging from 2.1 mi/mi2 to 9.2 mi/mi2. Fourteen sub-watersheds have no documented motorized routes.

4. Motorized route density within floodplain and riparian areas (buffered riparian) ranged from a high of 14 mi/mi2 to no routes in 20 sub-watersheds. Thirty-nine sub-watersheds are in the highest percentile (80-100) break category, having densities ranging from 3.2 mi/mi2 to 12.2 mi/mi2.

5. Motorized route crossing density was used as a measure of direct impacts to streams. Route crossing density ranged from no stream crossings in 26 sub-watersheds to a high of 9.3 crossings/mi2. Thirty-nine sub-watersheds are in the highest percentile (80-100) break category, having crossings densities ranging from 3.1 crossings/mi2 to 9.3 crossing/mi2.

6. Nine sub-watersheds were identified as having the greatest potential for road and trail related restoration of ARW resources. Restoration includes, but is not limited to, hydrologic upgrading of road drainage, disconnection of road drainage from stream courses, modification or replacement of culverts to provide passage for aquatic organisms or properly functioning floodplains, or closure/decommissioning of roads and trails.

Influences of Motorized Routes

A complete description of the influence of roads on Aquatic, Riparian and Wetland (ARW) ecosystems is provided in Winters et al. 2003, vers. 1.0). Motorized trails used by All Terrain Vehicles (ATV) or motorcycles have similar influence as roads and

therefore are included in the roads analysis. The following is a summary of potential effects due to roads and motorized trails:

Hydrology

- Watershed drainage patterns are altered and extended due to road/trail networks and road-drainage features.
- Road/trail building and use activities can increase surface runoff due to soil compaction; decrease interception and infiltration due to vegetation removal.

Water Quality

- Accelerated Erosion rates into streams and wetlands from road/trail surfaces and road cut/fill features.
- Chemical contamination from road/trail surface runoff.

Wetlands and riparian areas

- Direct disturbance from road construction or maintenance.
- Blockage and rerouting of surface and subsurface flows.
- Reductions in primary production of wetland and riparian plants from changes in water quality and sedimentation.

Channel conditions

- Alteration of channel geometry, substrate armoring and changes in substrate distribution at stream crossings.
- Changes in stream habitat features such as decreased pool volume and pool abundance from sediment loading.
- Reduction or loss of preferred spawning sized substrate.

Biotic Conditions

- Chemical contamination due to spills or road treatment products on aquatic life.
- Sediment can cause direct mortality or reduce fitness of aquatic life.
- Facilitate introductions of exotic species (plant and animal) and the spread of pathogens and disease (e.g., whirling disease) into aquatic ecosystems.
- Barriers to fish movement

Management Scale

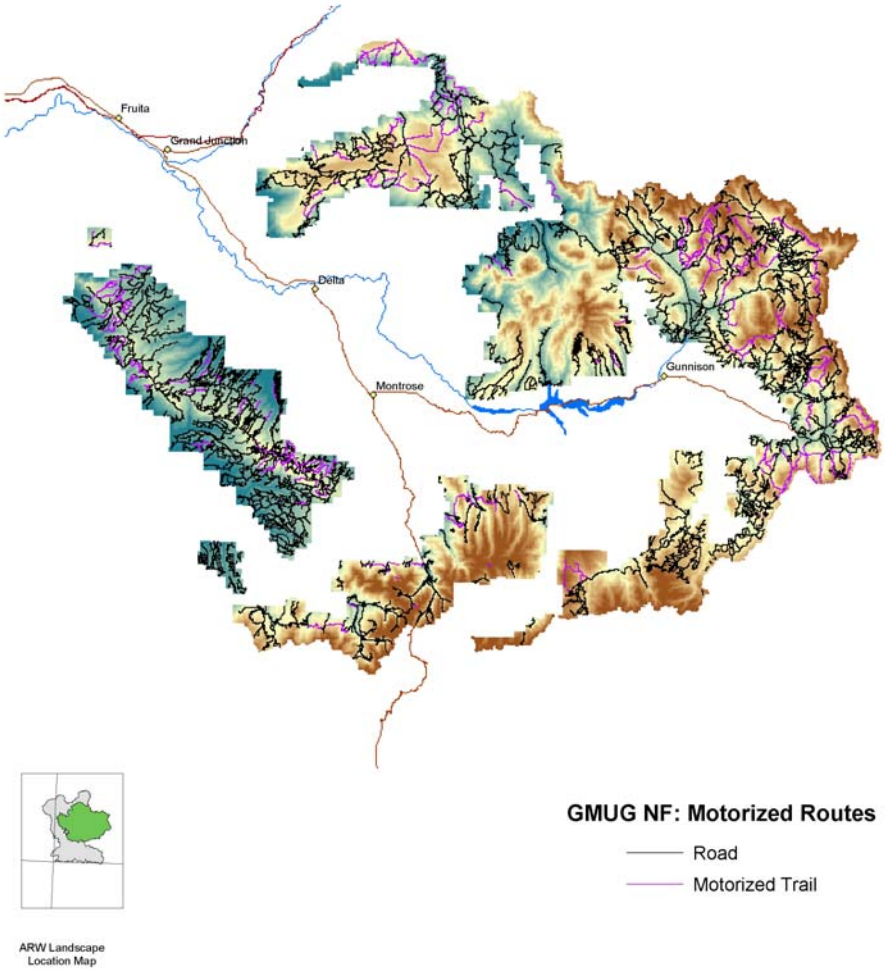
Forest-wide Summary

In January 2005, the GMUG completed a Roads Analysis Report in fulfillment of the 2001 National Forest System Road Management Rule (Grand Mesa, Uncompahgre and Gunnison National Forest, USDA Forest Service, 2005). The Rule required the Forest Service to complete and interdisciplinary science-based roads analysis to determine to ensure that additions to the transportation network are deemed essential for resource management and use. The analysis completed on the GMUG only addressed road maintenance levels 3-5 of approximately 950 miles of road or approximately 20% of system roads on the Forest. Road specific risks to forest resources and recommendations to minimize or eliminate risks are provided in the report. This assessment evaluates potential influences of all maintenance level roads (1-5) and motorized trails on ARW resources by 6th level sub-watersheds.

Travel routes (roads and trails) are divided into two categories: classified and un-classified. Classified travel routes are those within, partially within, or adjacent to a national forest boundary and necessary for protecting, administering, and using national forest lands. The Forest Service authorizes and maintains jurisdiction over those travel routes. Un-classified travel routes are either no longer required for management purposes, or have been created by users.

Available information regarding both classified and un-classified travel routes were included in the analysis. The analysis focused on the motorized portion of the entire travel route network and included 4,882 miles of road and 832 miles of motorized trail Forest-wide (Figure 5C3-1).

Figure 5C3-1. Locations of motorized routes (roads and motorized trails) within GMUG.



Sub-Watershed-Scale Summary

Motorized routes (roads and motorized trails) density at the 6th level HUB is an effective tool to evaluate risks to aquatic ecosystem health associated with roads and trails. To approximate these influences three measurements of effect were used targeting components of the aquatic ecosystem health – 1) influences on the sub-watershed, 2) floodplain and riparian vegetation, and 3) direct channel influences. A total of 223 sub-watersheds are presented in this analysis.

Sub-Watershed influence measure:

- Motorized route density (motorized route mi/mi2 in HUB)

Floodplain and riparian area/wetland influence measure:

- Buffered riparian motorized route density (mi/mi2 in HUB).

Buffered Riparian motorized route density was determined by buffering the GMUG riparian coverage by 100 feet and adding 100 foot buffers for any portions of perennial or intermittent channels not within the initial riparian buffer.

Direct channel influence measures:

- Motorized Route Crossing Density (#/mi2 in HUB)

Motorized route crossing density was determined based on the intersection of the motorized route cover and the total stream network.

Data limitation and display

Motorized routes are roads (paved and unpaved), and trails open to All-Terrain Vehicles (ATV) or motorcycles. Data used in the analysis is from the GMUG Infra coverage (September 2004). Infra data is subject to future updates and revision.

Several sub-watersheds analyzed have a low percent (<25%) of the entire land ownership in the sub-watershed administered by the Forest Service. Since data used in the analysis only provide a measure of potential road related impacts on NF lands and may not represent potential impacts for the entire sub-watershed. To better assist the Forest in determining which sub-watersheds have the greatest influence by motorized routes administered by the GMUG, sub-watersheds that have greater than 25% of the HUB administered by NF are highlighted in the analysis.

Sub-Watershed Influences

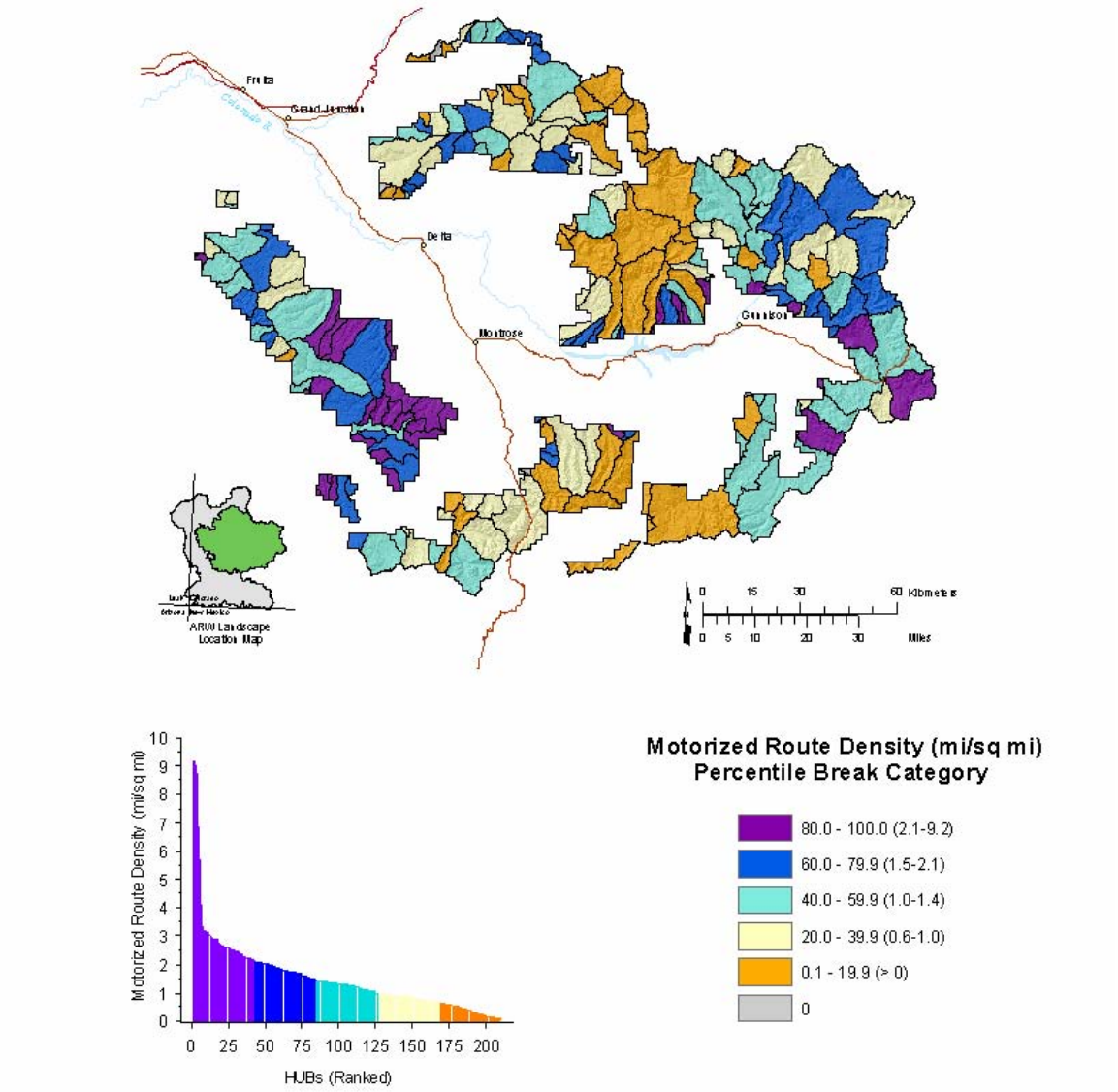
Motorized route density is a good indicator or the potential impacts of roads and trails on the hydrologic interaction of roads with the stream network (Wemple, 1994). Wemple found roads and trails can extend the natural stream network, thereby increasing efficiency of water and sediment delivery. This extension of the stream network altered watershed hydrology and can be the primary point sources of sediment to streams, wetlands and riparian areas in heavily roaded watersheds (Harr 1975).

Motorized Route Density

On the GMUG, motorized route density ranges from a high of 9.2 mi/mi2 in East Canyon sub-watershed, to no roads in 14 sub-watersheds (Figure 5C3-2). Forty-two sub-watersheds are in the 80-100 percentile category and range from a density of 9.2 mi/mi2 to 2.1 mi/mi2 (Table 5C3-1). Of these, 35 have more than 25% of their land base administered by the GMUG and have route densities ranging from 8.7 mi/mi2 in Coalbank/Big Sandy Creek sub-watershed to 2.1 mi/mi2 in Cabin Creek sub-watershed. Six of the sub-watersheds in the highest 20% category have 100 percent of their land base administered by the GMUG (Clear Creek, Hanks Creek, Red Creek, Little Red Canyon, Marshall Creek, and Sheep Creek). Clear Creek, Hanks Creek, Red Creek, and Little

Red Canyon sub-watersheds are on the south end of the Uncompahgre Plateau, Norwood Ranger District, in an area where timber harvest and to a lesser extent recreation is a dominant land use. The Marshall Creek sub-watersheds are located in the headwaters of the Gunnison Ranger District on the Gunnison Ranger District.

Figure 5C3-2. Rank and motorized route density (mi/mi2) for sub-watersheds on the GMUG.



Fifty-three sub-watersheds fall into the no (0) or lowest percentile categories (0-20 percentile) for motorized route density. Twenty-three of the sub-watersheds in the lowest percentile category, have a significant portion of their land base in wilderness area.

Table 5C3-1. Summary of HUBs within 80-100 Percentile Breaks for Motorized routes (roads and motorized trails) on GMUG. Bold text indicates sub-watersheds have greater than 25% of the land base administered by the GMUG.

HUC6_NAME	HUC6 Number	Motorized route density	Percent Sub-watershed National Forest	National Forest Acres	Percent Sub-watershed Wilderness
East Creek	140200054005	9.2	0	7	
Dry Ck	140200020306	9.1	5	171	
Coalbank/Big Sandy	**140200065002**	**8.7**	**27**	**2,334**	
Roatcap Gulch	140200065003	6.9	16	1,861	0
Hamilton Ck	**140300036105**	**5.7**	**62**	**618**	
Petrie Mesa	140200050901	4.1	0	40	
East Fk Dry Ck	**140200065001**	**3.4**	**47**	**16,385**	**0**
Spring Ck	**140200064001**	**3.2**	**46**	**17,878**	
Willow Ck	**140200020307**	**3.2**	**61**	**4,627**	**3**
Haypress Ck	**140200025307**	**3.1**	**37**	**649**	
Lower Tomichi C	140200038907	3.1	1	222	
MaveriCk Canyon	140300044203	3.0	14	2,156	
McKee Draw	**140300036102**	**2.9**	**74**	**4,337**	
Gunnison Rvr C	**140200025401**	**2.9**	**27**	**5,632**	
Happy Canyon Ck	**140200064002**	**2.9**	**27**	**6,554**	
Burn Canyon	**140300036103**	**2.9**	**25**	**823**	
Red Ck	**140200020303**	**2.9**	**54**	**4,963**	**0**
Clear Ck	**140300036506**	**2.7**	**100**	**5,094**	
Cottonwood Ck	**140200057703**	**2.7**	**46**	**9,613**	
Negro Ck	140200051302	2.7	1	54	
Hanks Ck	**140300036505**	**2.7**	**100**	**5,035**	
Pine Ck	140200024903	2.6	4	120	
Hot Spring Ck	**140200038902**	**2.6**	**74**	**21,241**	
Callan Draw	**140300036104**	**2.6**	**50**	**5,614**	
Bucktail Cks C	**140300034502**	**2.6**	**39**	**8,579**	
Beaver McKenzie C	**140300034706**	**2.5**	**43**	**14,680**	
Red Ck	**140300036503**	**2.5**	**100**	**8,260**	
Stevens Ck	**140200020308**	**2.5**	**52**	**2,881**	**3**
Potter Ck	**140200057702**	**2.5**	**61**	**21,886**	
Antelope Ck	140200020311	2.5	21	4,492	0
Upper Horsefly Ck	**140300036507**	**2.4**	**40**	**9,539**	
Little Blue	**140200024902**	**2.4**	**34**	**2,521**	
Lower Razor Ck C	140200035103	2.4	9	1,270	
Tuttle/Bramier Draws C	140300034503	2.3	19	557	
Little Red Canyon	**140300036504**	**2.3**	**100**	**7,875**	
West Pass Ck	**140200038703**	**2.3**	**89**	**27,621**	
Marshall Ck	**140200039102**	**2.3**	**100**	**36,632**	
Gibbler Gulch	140200054002	2.3	6	475	
Sheep Ck	**140300036502**	**2.2**	**100**	**4,431**	
West Roatcap Ck	140200045803	2.2	5	311	

HUC6_NAME	HUC6 Number	Motorized route density	Percent Sub-watershed National Forest	National Forest Acres	Percent Sub-watershed Wilderness
Dry Fk Escalante Ck	**140200057503**	**2.2**	**75**	**16,197**	
Cabin Ck	**140200038905**	**2.1**	**55**	**3,823**	

Floodplain and riparian area/wetland influence measures

Motorized routes in and immediately adjacent to riparian and wetland areas were examined to determine the amount of potential direct impact to ARW resources. A buffered riparian layer was used which includes the stream or lake, adjacent water dependent vegetation, floodplain, and the adjacent hillslope for a distance of 100 feet. Under the National Forest Management Act (NFMA) the Forest Service is required to give special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other water bodies. Motorized routes in this buffered zone have the most influence on aquatic system health and therefore present the highest potential for road related restoration. Influences on riparian/wetland areas that have been documented on the GMUG include:

- Roads parallel to streams resulting in constriction of the natural floodplains.
- Roads across floodplains that disrupt natural floodplain function and interception of ground water affecting stream and wetland recharge and altering plant community composition.
- Road fill failures due to concentration of flows off roads and/or roads constructed through geologically unstable areas.
- Restriction of flood flows due to insufficient culvert size. Impacts from under-sized culverts include flood flows over topping roads, floodplains filling upstream of the culvert, and chronic problems with beaver building dams on the inlet of culverts.

Motorized route density in buffered riparian range from a high of 14 mi/mi2 buffered riparian in Dry Creek sub-watershed to no routes in 31 sub-watersheds (Figure 5C3-3). There are 39 sub-watersheds in the highest percentile (80-100) category, 35 have greater than 25% of their land administered by the GMUG (Table 5C3-2). Buffered route densities range from a high of 12.2 mi/mi2 in Mckee Draw to 3.2 mi/mi2 in Steven's Creek sub-watershed. Nine sub-watersheds in this category have 100 percent of their land base administered by GMUG (Upper Quarts Creek, Long Branch Creek, Clear Creek, Marshal Creek, Gold Creek, Fischer Gulch, Spring Creek, Willow Creek and Upper Tomichi Creek). Eight of the nine sub-watersheds occur on the Gunnison Ranger District and the remaining sub-watershed is on the South end of the Uncompahgre Plateau (Ouray Ranger District). In these sub-watersheds, most of the motorized route impacts are associated with Forest Service roads or roads associated with historic mining.

Three sub-watersheds in the highest percentile category have greater than 10% of their land base in wilderness (Alder Creek, Gold Creek and Lower Taylor River). In these sub-watersheds motorized routes are concentrated on fewer acres and therefore

potentially more concentrated road related influences than the overall sub-watershed results would imply. One sub-watershed, Alder Creek, has 22% of the land base in the Fossil Ridge Wilderness area.

Sixty-seven sub-watersheds fall into the no (0) or low percentile categories (0-20) for motorized riparian route density. Five sub-watersheds have no roads within the buffer riparian. Cow Creek, Little Muddy, Coal Creek, and Clear Fork East Muddy Creek sub-watersheds are on the Paonia Ranger District in the headwaters of the North Gunnison River and Crystal Creek sub-watershed in headwaters of the Taylor River on the Gunnison Ranger District. Thirty-nine sub-watersheds in the low percentile category, have 25% or greater of their land base administered by the GMUG.

Figure 5C3-3. Rank and motorized route in buffered riparian density (mi/mi2 buffered riparian) for sub-watersheds on the GMUG.

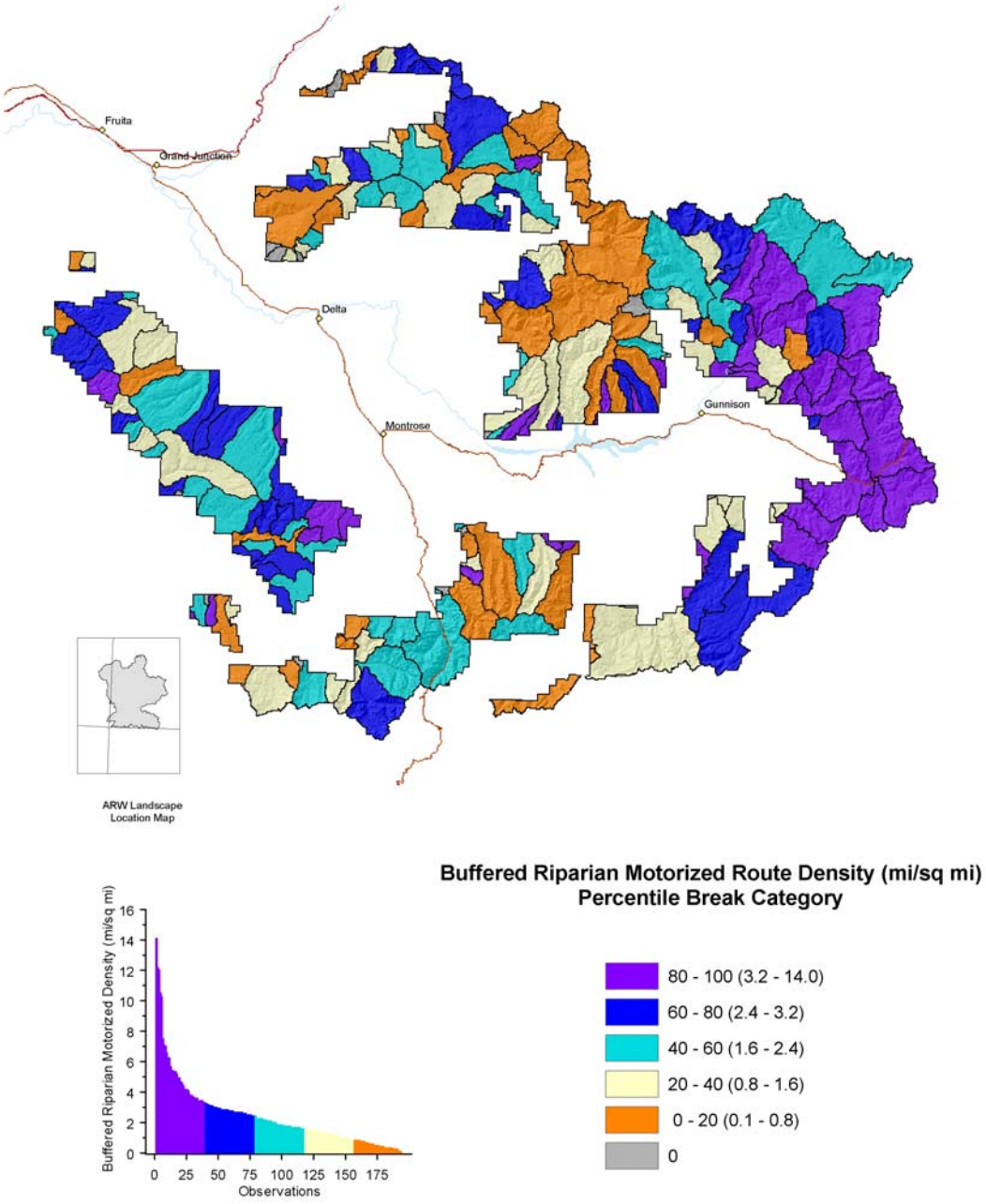


Table 5C3-2. Summary of sub-watersheds within 80-100 percentile breaks for Motorized routes (roads and motorized trails) in buffered riparian on GMUG. Bold text indicates sub-watersheds have greater than 25% of the land base administered by the National Forest.

HUC6_NAME	HUC6	Buffered Riparian Motorized Route Density	Percent Sub-watershed National Forest	National Forest Acres	Percent Sub-watershed in Wilderness
Dry Ck	140200020306	14.0	5	171	
McKee Draw	**140300036102**	**12.2**	**74**	**4,337**	
Red Ck	**140200020303**	**12.0**	**54**	**4,963**	**0**
Coalbank/Big Sandy	**140200065002**	**10.5**	**27**	**2,334**	
Lower Razor Ck C	140200035103	10.3	9	1,270	
Antelope Ck	140200020311	7.5	21	4,492	0
Hamilton Ck	**140300036105**	**7.1**	**62**	**618**	
West Pass Ck	**140200038703**	**7.0**	**89**	**27,621**	
Upper Quartz Ck	**140200039304**	**6.6**	**100**	**25,919**	
Mid Tomichi Ck C	**140200038901**	**6.3**	**70**	**47,245**	
Haypress Ck	**140200025307**	**6.2**	**37**	**649**	
Hot Spring Ck	**140200038902**	**5.7**	**74**	**21,241**	
Clear Ck	**140300036506**	**5.4**	**100**	**5,094**	
Long Branch Ck	**140200039101**	**5.4**	**100**	**15,490**	
Cement Ck	**140200019904**	**5.3**	**97**	**21,953**	
Marshall Ck	**140200039102**	**5.3**	**100**	**36,632**	
Upper Razor Ck	**140200035101**	**5.2**	**88**	**22,203**	
Little Blue	**140200024902**	**4.9**	**34**	**2,521**	
North Fk Mesa Ck	**140300044301**	**4.9**	**36**	**12,767**	
Gold Ck	**140200039303**	**4.7**	**100**	**19,457**	**14**
Alder Ck	**140200039302**	**4.6**	**73**	**7,990**	**22**
Rock Ck/Fish Canyon C	140200028501	4.4	11	5,501	
Fischer Gulch	**140200025403**	**4.2**	**100**	**2,629**	
Spring Ck	**140200019505**	**4.2**	**100**	**43,940**	
Corral Ck	**140200025306**	**4.2**	**43**	**1,687**	
Lower Quartz Ck C	**140200039301**	**4.1**	**79**	**24,534**	
Spring Ck	**140200064001**	**3.8**	**46**	**17,878**	
Leaps Gulch	**140200025402**	**3.8**	**83**	**5,852**	
Lower Taylor Rvr C	**140200019501**	**3.7**	**98**	**38,325**	**13**
Willow Ck	**140200019507**	**3.6**	**100**	**40,620**	**0**
Gunnison Rvr C	**140200025401**	**3.6**	**27**	**5,632**	
Myers Gulch	**140200025304**	**3.6**	**58**	**3,427**	
Little Henderson Ck	**140200040905**	**3.6**	**99**	**5,296**	
Happy Canyon Ck	**140200064002**	**3.4**	**27**	**6,554**	
Owl Ck	**140200064802**	**3.4**	**90**	**4,238**	**6**
Mesa Ck	**140200025303**	**3.4**	**84**	**7,126**	
Willow Ck	**140200028304**	**3.4**	**25**	**1,948**	
Upper Tomichi Ck	**140200039103**	**3.3**	**100**	**58,230**	
Stevens Ck	**140200020308**	**3.2**	**52**	**2,881**	**3**

Motorized Route Crossing Density (#/mi2)

Motorized route crossing density was used as a measure of direct channel impacts to streams. The amount of road and trail use, construction, and maintenance can degrade channel morphology and affect aquatic integrity, especially where roads and trails cross streams (Waters, 1995, Hagans, et al, and Heede 1980). Alterations may include changes in channel morphology, modifications to the stream longitudinal profile, and modification or loss of spawning and pool habitats (USDA Forest Service, 2003).

Besides sediment related impacts to aquatic life, stream crossing can also have a significant affect on movement patterns of fish, amphibian and macroinvertebrates. The full extent of road related passage issues on the GMUG is not known since comprehensive surveys have not been completed. Surveys addressing potential affects of stream crossings on fish passage and floodplain function have been initiated in 2005 by the Forest aquatic staff.

Motorized route stream crossing density ranged from a high of 9.3 /mi2 in Naturita Creek to no crossings in 26 sub-watersheds (Figure 5C3-4) Thirty-nine sub-watersheds are in the highest 80-100 percentile category and range from 9.3 crossings per mi2 in Hamilton Creek to 3.1 crossings per mi2 in Terror Creek (Table 5C3-3). Three sub-watersheds (Little Henderson, Clear Creek and Red Creek) have 100% of their land base administered by the GMUG. Clear Creek and Red Creek sub-watersheds are located in the Horsefly drainage on the Uncompahgre Plateau and Little Henderson Creek in the Muddy Creek drainage of the North Fork Gunnison River. Thirty-nine sub-watersheds in the highest percentile category have 25% or greater or their land base administered by the GMUG.

Sixty-five sub-watersheds fall into the no (0) or low percentile category (0-20) for motorized riparian route density. Of the 65, forty sub-watersheds have greater than 25% of their land base administered by Forest Service.

Figure 5C3-4. Rank and motorized route stream crossing density (#/mi2) in 6th level sub-watersheds on the GMUG.

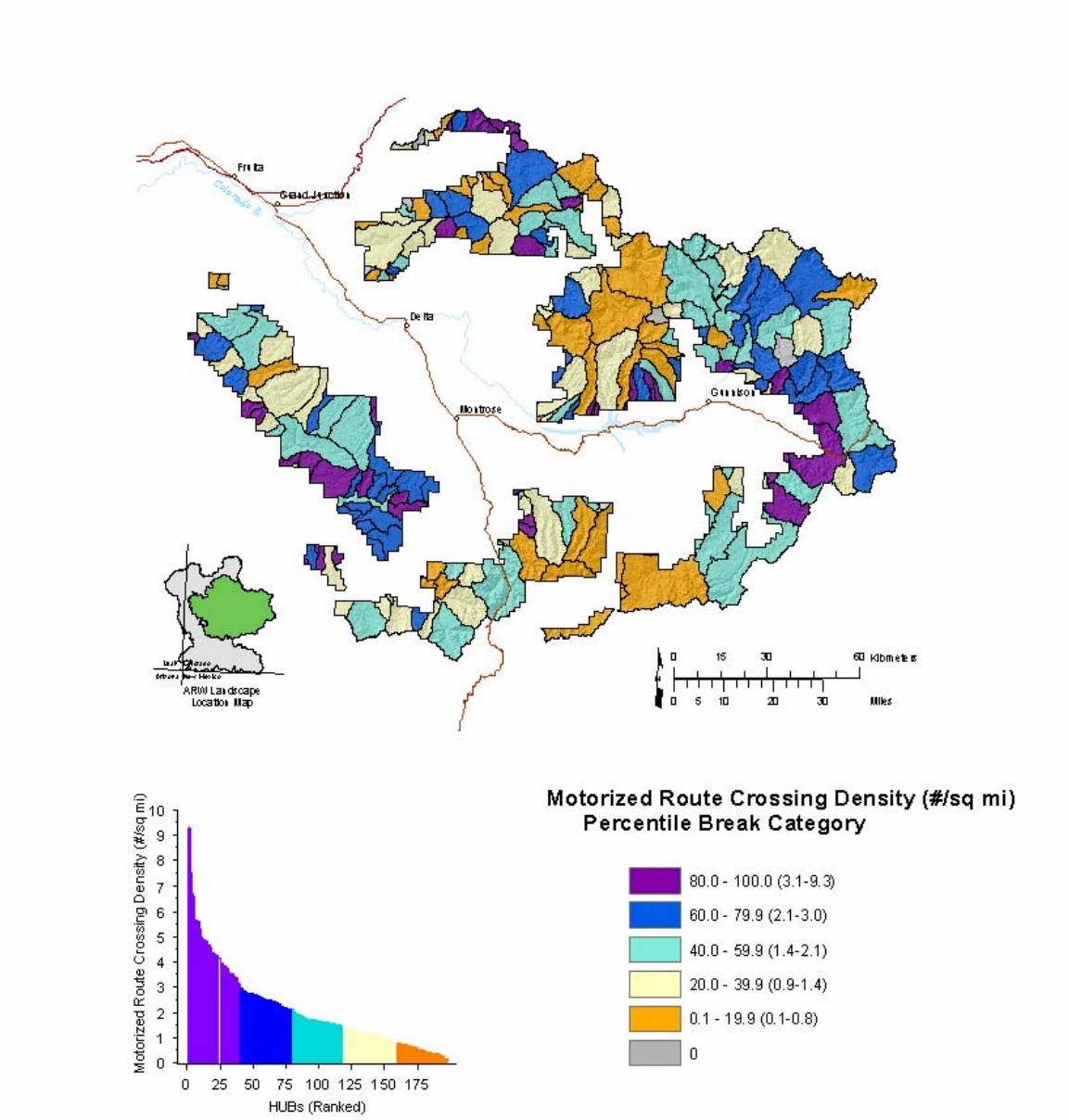


Table 5C3-3. Summary of sub-watersheds within 80-100 Percentile Break for Motorized Route Crossings Density on GMUG. Bold text indicates sub-watersheds have greater than 25% of the land base administered by the GMUG.

HUC6_NAME	HUC6	Motorized Route Crossing Density	Percent Sub-watershed National Forest	National Forest Acres	Percent Sub-watershed in Wilderness
Hamilton Ck	**140300036105**	**9.3**	**62**	**618**	
Burro Ck	140200064806	9.3	11	757	
Dry Ck	140200020306	7.5	5	171	
Clear Ck	**140300036506**	**6.7**	**100**	**5,094**	
Lower Razor Ck C	140200035103	6.5	9	1,270	
Corral Ck	**140200025306**	**5.7**	**43**	**1,687**	
Little Henderson Ck	**140200040905**	**5.7**	**99**	**5,296**	
Maverick Canyon	140300044203	5.6	14	2,156	
Spring Ck	**140300036704**	**5.6**	**35**	**4,685**	
Red Ck	**140200020303**	**5.3**	**54**	**4,963**	**0**
Gunnison Rvr C	**140200025401**	**5.0**	**27**	**5,632**	
Nate Ck	**140200064803**	**4.9**	**74**	**3,270**	
Stevens Ck	**140200020308**	**4.9**	**52**	**2,881**	**3**
Road Gulch	**140100051905**	**4.8**	**81**	**6,603**	
Owl Ck	**140200064802**	**4.8**	**90**	**4,238**	**6**
Cottonwood Gulch	**140200025308**	**4.7**	**34**	**1,233**	
Burn Canyon	**140300036103**	**4.7**	**25**	**823**	
Upper Horsefly Ck	**140300036507**	**4.6**	**40**	**9,539**	
Coalbank/Big Sandy	**140200065002**	**4.4**	**27**	**2,334**	
West Pass Ck	**140200038703**	**4.4**	**89**	**27,621**	
Red Ck	**140300036503**	**4.3**	**100**	**8,260**	
Willow Ck	**140200020307**	**4.3**	**61**	**4,627**	**3**
Atkinson Ck	**140300034507**	**4.3**	**31**	**5,979**	
Hot Spring Ck	**140200038902**	**4.2**	**74**	**21,241**	
McKee Draw	**140300036102**	**4.0**	**74**	**4,337**	
Haypress Ck	**140200025307**	**3.9**	**37**	**649**	
Bucktail Cks C	**140300034502**	**3.9**	**39**	**8,579**	
Wood Gulch	**140200038903**	**3.8**	**29**	**2,163**	
Roatcap Gulch	140200065003	3.8	16	1,861	0
Brush Ck	**140100051904**	**3.7**	**74**	**8,380**	
Lower Buzzard C	**140100051901**	**3.6**	**30**	**11,542**	
Maverick Draw	140300036106	3.6	13	3,236	
Alder Ck	**140200039302**	**3.5**	**73**	**7,990**	**22**
Prosser Ck	**140200035102**	**3.5**	**57**	**2,547**	
Mid Tomichi Ck C	**140200038901**	**3.4**	**70**	**47,245**	
Coal Ck	140300034505	3.4	19	4,336	
Cottonwood Ck	**140300034501**	**3.4**	**89**	**29,141**	
Kiser Ck	**140200051307**	**3.2**	**41**	**8,884**	
Terror Ck	**140200041103**	**3.1**	**74**	**13,992**	

Reach/Site Scale Analysis

In order to identify specific influences from roads on aquatic, riparian, and wetland resources, analysis at the reach/site scale is critical. Table 5C3-4 provides direction for prioritization of sub-watersheds for analysis at the reach or site level. The HUBs have been identified to have the highest risk of motorized route related impacts. The table was derived by combining sub-watersheds in the 80-100 percentile break categories for motorized route density, buffered riparian route density, culvert density, and local knowledge from Forest personnel. Consideration of resource values potentially at risk from road influences should be considered when determining the need for site-specific analysis (e.g. presence of threatened, endangered, or sensitive aquatic species, fishery values, etc.).

Table 5C3-4. Sub-watersheds with 25% or greater of their land base administered by the GMUG in highest break category for motorized route density, buffered riparian density, and stream crossing density. Depending upon aquatic resource values potentially at risk, these sub-watersheds may provide the best opportunity for road related restoration.

HUB6	Name	Ranger District	Factor potentially affecting aquatic integrity
140200065002	Coalbank/Big Sandy	Ouray Ranger District	Crossing density:8.7 mi/ mi^2 Buffered riparian: 10.5 mi/ mi^2 Motorized Crossing Density:4.4/ mi^2
140300036105	Hamilton Creek	Norwood Ranger District	Crossing density:5.7 mi/ mi^2 Buffered riparian: 7.1 mi/ mi^2 Motorized Crossing Density:9.3/ mi^2
140200064001	Spring Creek	Ouray Ranger District	Crossing density:3.2 mi/ mi^2 Buffered riparian: 7.1 mi/ mi^2 Motorized Crossing Density:9.3/ mi^2
140200025307	Haypress Creek	Gunnison Ranger District	Crossing density:3.1 mi/ mi^2 Buffered riparian: 5.7 mi/ mi^2 Motorized Crossing Density:3.9/ mi^2
140300036102	McKee Draw	Norwood Ranger District	Crossing density:2.9 mi/ mi^2 Buffered riparian: 12.2 mi/ mi^2 Motorized Crossing Density:4.0/ mi^2
140200025401	Gunnison River C	Gunnison Ranger District	Crossing density:2.9 mi/ mi^2 Buffered riparian: 3.6 mi/ mi^2 Motorized Crossing Density:5.0/ mi^2
140300036506	Clear Creek	Ouray Ranger District	Crossing density:2.7 mi/ mi^2 Buffered riparian: 5.4 mi/ mi^2 Motorized Crossing Density:6.7/ mi^2
140200038902	Hot Spring Creek	Gunnison Ranger District	Crossing density:2.6 mi/ mi^2 Buffered riparian: 5.7 mi/ mi^2 Motorized Crossing Density:4.2/ mi^2
140200020308	Stevens Creek	Gunnison Ranger District	Crossing density:2.5 mi/ mi^2 Buffered riparian: 3.2 mi/ mi^2 Motorized Crossing Density:4.9/ mi^2

Specific questions related to road and trail influences at the site/reach scale include:

1. What and how are aquatic ecosystems and resources dependent values are potentially at risk from road and trail influences?
2. Are the crossings adequate to pass the design flow including associated debris?
3. Is the placement of the road affecting the valley bottom or impairing floodplain function?
4. Is the crossing appropriate for the expected traffic levels?
5. Is fish passage an issue? If so, is the crossing designed to allow unimpeded passage of aquatic organisms?
6. Are Best Management Practices adequate to prevent chronic inputs of sediment into the stream?
7. Are there opportunities to eliminate or re-route roads or trails that pose significant risk to ARW resources?

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

Vegetative Treatments

Key Findings

1. Over the last 50 years 135,800 acres of vegetation treatments have occurred. This represents 4.3% of the total GMUG land base.
2. Twenty-nine 6th HUC sub-watersheds have 50-years of cumulative treatments exceeding 12% of their individual areas. Combined they acreage of these sub-watersheds is less than 10% of the Forest total acreage. Three 6th HUC sub-watersheds have cumulative treatments exceeding 42% of their areas
3. Seventy-eight 6th HUC sub-watersheds have no record of vegetation treatments within the last 50 years. The total acreage of these watersheds is 17.5% of the Forest base.
4. The greatest concentration of vegetation treatments is located on the southern 2/3 of the Uncomphagre Plateau. Eleven of the 28 watersheds with the greatest acreage treated are located on the Uncompahgre Plateau.
5. The persistence of affects of vegetation treatments is highly variable. Incorporation of recovery towards pre-treatment would require more detailed investigations at a site-specific scale.

Influences of Vegetation Treatments

Vegetative treatments can have significant influences on aquatic systems, potentially altering both biophysical processes and vegetative structure on hill slopes and valley bottoms. In addition, the site disturbance associated with mechanized operations can lead to an increase in sediment production and delivery, which may lead to changes in aquatic/riparian habitat quality. Typically the erosion related affects of site disturbance associated with treatments are short lived, lasting only as long as it takes to get vegetation cover re-established. Generally this occurs within three to ten years.

Changes in runoff and water yield following vegetative type conversion or reductions in biomass depend upon the vegetation community type and specifics of the treatment, and may persist from 20 to 60 years.

More complete treatment of the influence of various vegetative treatments on aquatic, riparian and wetland ecosystems is provided in Winters et al., 2003, vers. 1.0). The following is a summary of potential direct effects due to vegetative treatment:

Hydrology

- Alteration of snow accumulation within stands and openings; and adjustments in rates and timing of snowmelt.
- Reduction in evapotranspiration rates and in precipitation interception losses.
- Increases in annual runoff from harvested areas and adjustments to duration and timing of runoff.
- Increases in soil moisture

Water Quality

- Harvesting in streamside zones may increase solar input resulting in increased water temperatures.
- Activities associated with canopy removal may include road construction, road maintenance and use; skidding and decking operations; slash disposal and site preparation. These ground disturbing activities can increase erosion and sediment delivery to the drainage network.
- Increases in sediment caused by channel scour associated with increased flows. For this to occur it takes removal of a significant percentage of the forested areas within a watershed (>25%).
- Harvesting of forested watersheds may increase nutrient export of inorganic elements (e.g., Nitrogen, Phosphate, Potassium and Calcium). Increases in nutrients may increase primary production, which can have both beneficial and negative effects.

Channel Condition

- Channel destabilization associated with increased flows.
- Increases in sediment may increase substrate embeddness and reduce pool volume.
- Tree removal along streamside areas can result in a loss of large in-channel wood over time.

Uplands

- Soil compaction.
- Increased overland flow and decreased infiltration.

Biotic

- Increased water temperatures can affect aquatic species composition, delay egg development, increase susceptibility to disease and increase food production.
- Loss of woody debris can reduce cover, habitat complexity and pool quality.
- Increases in sediment deposition can reduce oxygen within inter-gravel spaces and reduce spawning success.

Management Scale

Forest-wide Summary

Three separate information sources were combined in order to estimate the sub-watershed extent of vegetative manipulation or treatment. The three sources were the Rocky Mountain Activities (RMACT) database, GMUG GIS coverage of major utility corridors, and the GMUG GIS coverage of ski runs (see also Appendix E.) RMACT treatments used include commercial regeneration & thinnings, salvage, mechanical site preparation as well as various mechanical brush and fuels treatments. Based on that information, a total of 135,800 acres have been treated over the past 50 years. Collectively that represents approximately 4.5% of the GMUG. The treatment areas identified and included in the total are displayed in Figure 5C4-1.

Watershed Scale Summary

Risks associated with vegetative treatments were evaluated based on the proportion of each watershed that had been treated over the past 50 years.

Watershed influence measure:

- Percent Treated (% of HUC6 area).

Data Limitations

The effects of all included treatments are assumed equal regardless of type and age of treatment. No projected runoff or sediment production recovery was applied, nor conversion to a equivalent roaded or clearcut acre basis. The accuracy of available RMACT information is best for most recent activities.

Watershed Influences

Percent Treated

Vegetation treatment has occurred to varying extents on 145 sub-watersheds (6^{th} HUC) over the last 50 years, while seventy-eight have no record of treatments. The forest-wide results by percentile groups is displayed in Figure 5C4-2. The highest 20% of sub-watersheds (29 total) range from nearly 12% of the GMUG portion receiving some treatment to a high of 61% in the Little Blue sub-watershed (Table 5C4-1).

The southern portion of the Uncompahgre Plateau and the Naturita division have the highest concentrations of historic treatment across the GMUG (Figure 5C4-2) and include 18 of the highest 29 listed in Table 5C4-1. Other notable areas occur in Cochetopa Creek, and Mid Taylor River & Spring Creek.

Table 5C4-1. Highest 20th percentile sub-watersheds (% of GMUG treated).

SUB-WATERSHED NAME	HUC6	% Treated	% NF	NF Acres
Little Blue	140200024902	61.3	34	2,521
McKee Draw	140300036102	44.0	74	4,337
Burn Canyon	140300036103	41.3	25	823
MaveriCk Canyon	140300044203	29.2	14	2,156
Bucktail Cks C	140300034502	27.0	39	8,579
Antelope Ck	140200020311	25.3	21	4,492
Maverick Draw	140300036106	24.0	13	3,236
Lower South Beaver	140200025002	23.1	2	387
East Fk Dry Ck	140200065001	22.7	47	16,385
Willow Ck	140200020307	21.7	61	4,627
Spring Ck	140200064001	21.6	46	17,878
Hot Spring Ck	140200038902	20.8	74	21,241
Big Ck	140100051710	19.6	93	15,468
Sheep Ck	140300036502	18.4	100	4,431
Kiser Ck	140200051307	18.3	41	8,884
Albin Draw	140300036508	18.2	100	5,659
Dry Fk Escalante Ck	140200057503	17.0	75	16,197
Clear Ck	140300036506	16.2	100	5,094
Naturita Ck	140300036101	15.6	16	19,497
Potter Ck	140200057702	14.2	61	21,886
Beaver McKenzie C	140300034706	14.0	43	14,680
Myers Gulch	140200025304	13.4	58	3,427
Callan Draw	140300036104	13.3	50	5,614
Mesa Ck	140200025303	13.2	84	7,126
West Pass Ck	140200038703	13.0	89	27,621
Coalbank/Big Sandy	140200065002	12.8	27	2,334
Horsefly Ck C	140300036501	12.7	93	11,147
Cottonwood Ck	140300034501	12.1	89	29,141
Mesa Ck	140100051716	11.7	37	7,677

Figure 5C4-1. GMUG Vegetative Treatments.

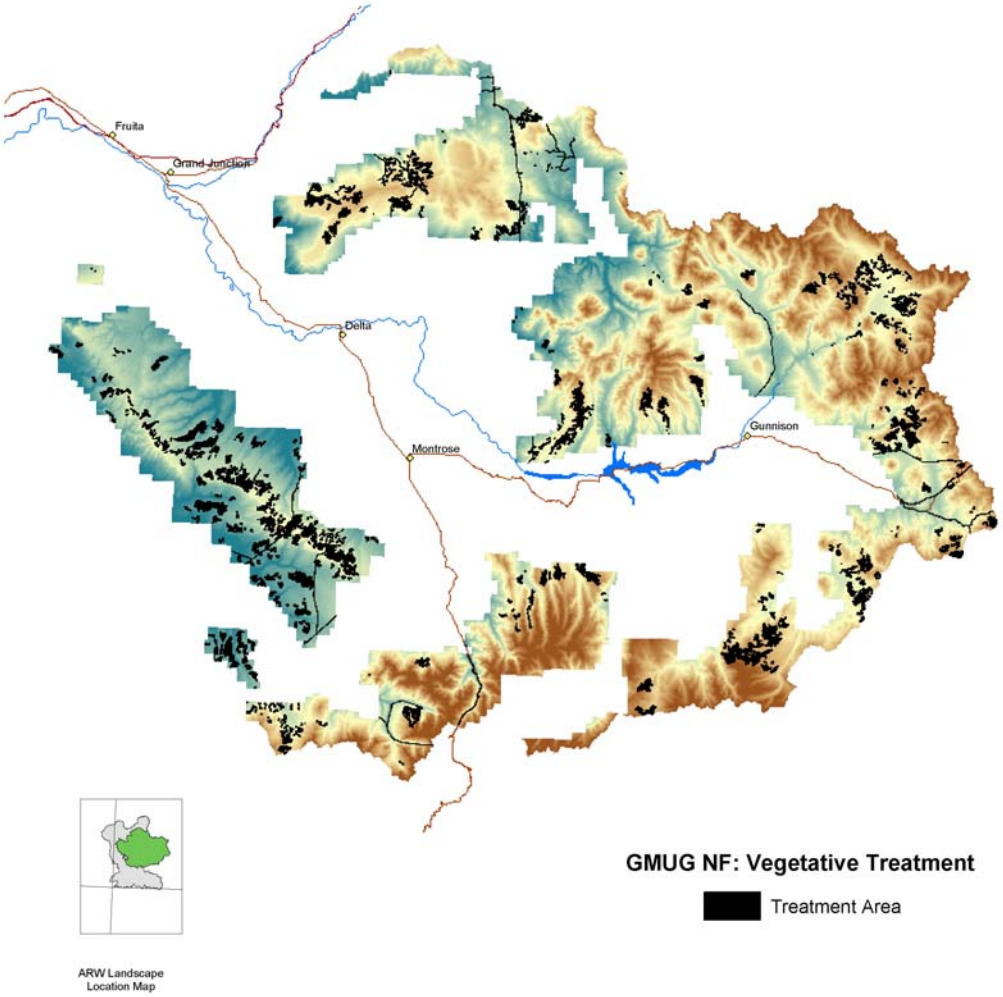
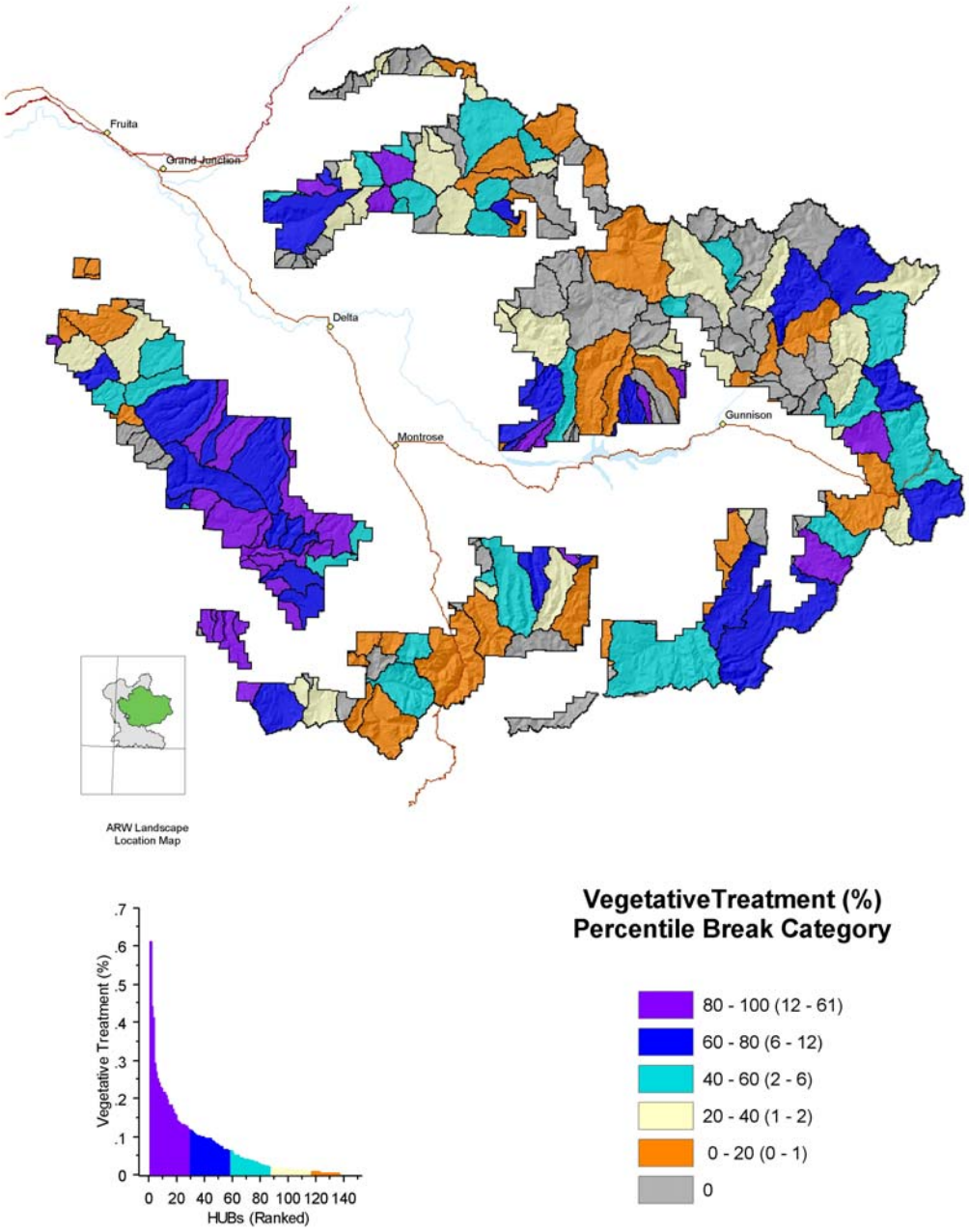


Figure 5C4-2. Rank and percentage of GMUG treated.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

Recreation

Key Findings

1. There are 69 sub-watersheds (6th level HUC) within the GMUG with high streamside recreational use. Sub-watersheds with the greatest or highest percentage of stream affected (the top 20 percentile group) constitute 14 sub-watersheds and are located in the Grand Mesa and the Gunnison Geographic Areas.

2. Almost 70 percent of the 6th level HUC sub-watersheds have no identified streamside recreational use. Over 93 percent of the 6th level HUC sub-watersheds on the GMUG have less than 10 percent of the stream network affected.

3. When assessing the risk of recreational impacts using actual stream miles, the Gunnison GA has the highest total stream miles affected.

4. Of the sub-watersheds that rank in the highest 20th percentile based on the percentage of stream network affected, six also rank in the top 20th percentile of actual stream miles affected. Those sub-watersheds are: Leon Creek, East Leroux Creek, Middle East River Composite, Cement Creek, Upper Quartz Creek, and Surface Creek.

Influences of Recreation

The major or key recreational use activities occurring on National Forest lands include; ski areas, camping and picnicking sites, motorized trails (ATV and OHV use), hiking/riding trails (bicycles, pedestrians, and horses), river floating, boating, and fishing. These recreational use activities all can have direct effects in terms of their influence on the different components of the aquatic, riparian, and wetland ecosystems.

A comprehensive description of the effects various recreational uses have on aquatic, riparian, and wetland ecosystems on National Forest lands is provided in Winters et. al. (2003, vers. 1.0). A summary of effects that may influence GMUG aquatic, riparian, and wetland ecosystems are:

Hydrology

- Increased or expanded impervious surfaces due to paving or compaction for parking and access that increases runoff and overall increases in non-point source pollution.

- Water diversions or withdrawals for snow making that can deplete winter base stream flow.

- Increased snow pack that results from snow making can alter the spring runoff volume and change downstream spring flow regimes (hydrograph).

Water Quality

- Localized scouring and accelerated erosion can occur where human use has compacted soils or denuded areas of natural vegetation

- Runoff from parking areas may be contaminated with petroleum residues, heavy metals, and salts associated with vehicles.

- Uncontrolled or improper disposal of human waste can pollute streams or groundwater.

- Vegetation removal along stream courses associated with recreational use (trampling) or harvesting (ski runs) can reduce shading that can influence water temperatures by raising them in the summer or lower them in the winter.

Riparian and Wetland Areas

- Recreational users are drawn to riparian zones because of their proximity to water and consequently are often trampled and cut to provide access to the stream for fishing or aesthetic reasons.

- Soil compaction associated with vehicle travel, hiking, fishing and camping in the water influence zone can result in root exposure, stream bank shearing, and loss of organic matter.

Channel Condition

- Concentrated use along stream banks can cause stream bank collapse and bank sloughing creating channel instability or channel widening.

- Increased peak flows resulting from additional snow pack in ski areas has the ability to create more incised or wider stream channels downstream of NFS lands.

- Increased peak flows have the ability to affect channel substrate and channel morphology downstream of NFS lands.

Biotic Condition

- Fish populations can be adversely affected by recreational fishing if intense enough to alter age classes and the inter-relationship to competing species.

- Changes in physical conditions of streams (hydrograph, morphology, and quality) can alter the invertebrate populations both in numbers and variety of species as well as increase or decrease aquatic vegetation.

- Introduction of invasive species by the public to created desired recreational fisheries.

Management Scale

Forest-wide Summary

On the GMUG the most complete information regarding recreational use activities is an inventory of high frequency streamside recreational use, and developed sites within 300 feet of stream channels. While this provides the best available on-the-ground inventory of near stream recreational uses, it does not capture all of the recreational use activities that occur along or adjacent to streams on the GMUG. Much of that streamside recreational use is dispersed and intermittent in nature. Forest-wide 363 stream miles or 2.3% of the total network, have high frequency recreational us (Figure 5C5-1).

The influences on aquatic, riparian, and wetland ecosystems by other recreational use activities such as ski areas and motorized trail riding (ATV and OHV travel) were included under other land-use activity categories. On the GMUG, these other recreational use activities have effects that are nearly identical to the influences related to a similar, yet larger category of land-use activities. For example, one key direct effect of ski area development is clearing vegetation for ski runs and facilities (Winters et al., 2003). This effect is captured by the larger category of "clear cuts" under the land-use activities assessment since ski run construction is a complete type conversion of that forested acreage. Similarly, motorized trails that are used predominately for recreational purposes are captured under the larger categories for motorized travel that measure road densities and road crossings in water influence zones. There was no data, inventory, or information to evaluate the effects of fishing on the aquatic, riparian, and wetland ecosystems on the GMUG, but much of the more intensive fishing activity locations are included in the streamside recreational use inventory. While there is considerable biotic community sampling for many of the streams within the GMUG, there is little indication that fishing has seriously affect populations or species diversity.

In analyzing ski area influences on aquatic, riparian, and wetland ecosystems the miles of stream on National Forest lands below the ski area is used to quantify affects. On the GMUG there are three ski areas permitted on National Forest land. None of these ski areas have streams on National Forest lands below the permitted ski area. All of the stream segments below the ski areas are on private lands. Therefore this measure of aquatic, riparian, and wetland ecosystem influence for the GMUG was not used.

According to Winters et.al. (2003) the other effects on aquatics, riparian, and wetland ecosystems resulting from recreational use are indirect effects or secondary impacts related to travel, vehicles, and land development. For this reason, the recreational influences were evaluated based on direct effect, and under this category is limited to recreation sites along streams.

Watershed Scale Summary

The risks associated with near stream recreational uses were evaluated based on the calculated percentage of the total stream network and actual miles by 6th level HUC sub-watersheds.

Floodplain and riparian area/wetland influence measure:

- Stream miles potentially affected (% of total stream network)

Floodplain and riparian area / wetland influences

Of the 225 sub-watersheds only 69 have streams where high intensity streamside recreational use was identified. When they are ranked by percentiles, the top 20 percent or the highest percentile group (14 sub-watersheds) are located in two Geographic Areas (GA), half on the Grand Mesa and the other half are within the Gunnison GA.

Based on percentage of stream affected by recreational use, the highest level of impact was less than 25 percent of the total stream network. Percentage of stream affected is depicts the ratio of miles of stream affected to total miles of stream network. Therefore all of the 6th level HUC sub-watersheds have less than a one to four (1:4) ratio of stream miles affected to total miles of stream.

Oak Creek and Doughspoon Creek sub-watersheds on the Grand Mesa and Copper Creek in the East River drainage of the Gunnison GA have over 20 percent of the stream length affected (Table 5C5-1). Of the top 20 percentile sub-watersheds affected by streamside recreational use, the range of percent of stream affected was between 10 and 23 percent. The majority of streams (6th level HUC sub-watersheds) have no streamside recreational use impacts (69 percent). Using a criteria of streams with less than 10 percent affected, over 93 percent of the 6th level HUC sub-watersheds on the GMUG have limited or no affect from streamside recreational use.

Table 5C5-1. Top 20th Percentile Sub-watersheds (% of total stream network)

Geographic Area	6th Level HUC	Sub-watershed Name	Percentage of Stream	Percent of NF land in the Sub-watershed
Grand Mesa	140200051304	Oak Creek	23.1	34
Gunnison	140200019909	Cooper Creek	22.0	100
Grand Mesa	140200051303	Doughspoon Creek	20.2	37
Gunnison	140200019907	Middle East River Composite	17.8	96
Grand Mesa	140200051307	Kiser Creek	17.7	41
Grand Mesa	140100051716	Mesa Creek	16.4	37
Grand Mesa	140200045801	East Leroux Creek	14.9	79
Gunnison	140200019910	Upper East River	13.2	100
Gunnison	140200019904	Cement Creek	13.1	97
Gunnison	140200019508	Texas Creek	13.0	100
Gunnison	140200039304	Upper Quartz Creek	12.9	100
Grand Mesa	140200051309	Surface Creek	11.1	69
Gunnison	140200039303	Gold Creek	10.3	100
Grand Mesa	140100051707	Leon Creek	10.0	96

While this comparison of streamside recreational use by 6th level HUC sub-watersheds and is based on percent of the stream affected, it is also important to consider the actual miles of stream affected by high intensity streamside recreational use (Table 5C5-2).

Of the sub-watersheds that rank in the highest 20th percentile based on percentage of the network affected, six of also rank in the highest 20th percentile of actual miles of stream affected. The Gunnison GA has the most actual stream miles affected. The East River sub-watershed has three 6th level HUC watershed stream segments that have a combined total of 44.1 actual miles of streamside recreational use. The Taylor River (both upper and lower segments) has a total of 29.3 actual stream miles affected and Quartz Creek (both upper and lower segments) 23.9 miles. All of these sub-watersheds are within the Upper Gunnison River basin.

Table 5C5-2. Top 20th Percentile Sub-watersheds (actual stream miles)

Geographic Area	6th Level HUC	Sub-watershed Name	Miles of Stream Affected	Ratio of Stream Miles Affected to Total Miles of Stream Network
Gunnison	140200019501	Lower Taylor River Composite	18.2	1 to 11.5
Grand Mesa	140100051707	Leon Creek	17.3	1 to 10
Grand Mesa	140200045801	East Leroux Creek	17.0	1 to 6.7
Gunnison	140200019907	Middle East River Composite	15.2	1 to 5.6
Gunnison	140200019904	Cement Creek	15.0	1 to 7.6
Grand Mesa	140100051906	Upper Buzzard Creek	14.2	1 to 17
Gunnison	140200019908	Slate River	13.9	1 to 12
Gunnison	140200039304	Upper Quartz Creek	13.5	1 to 7.7
North Fork	140200040702	Coal Creek	13.1	1 to 30
Gunnison	140200019505	Spring Creek	12.5	1 to 15
Grand Mesa	140200051309	Surface Creek	11.7	1 to 9
Gunnison	140200019509	Upper Taylor River	11.1	1 to 13.8
Gunnison	140200028502	Upper Cebolla Creek	10.7	1 to 37
Gunnison	140200039301	Lower Quartz Creek Composite	10.4	1 to 13.7

Figure 5C5-1. Streamside High Frequency Recreational Sites.

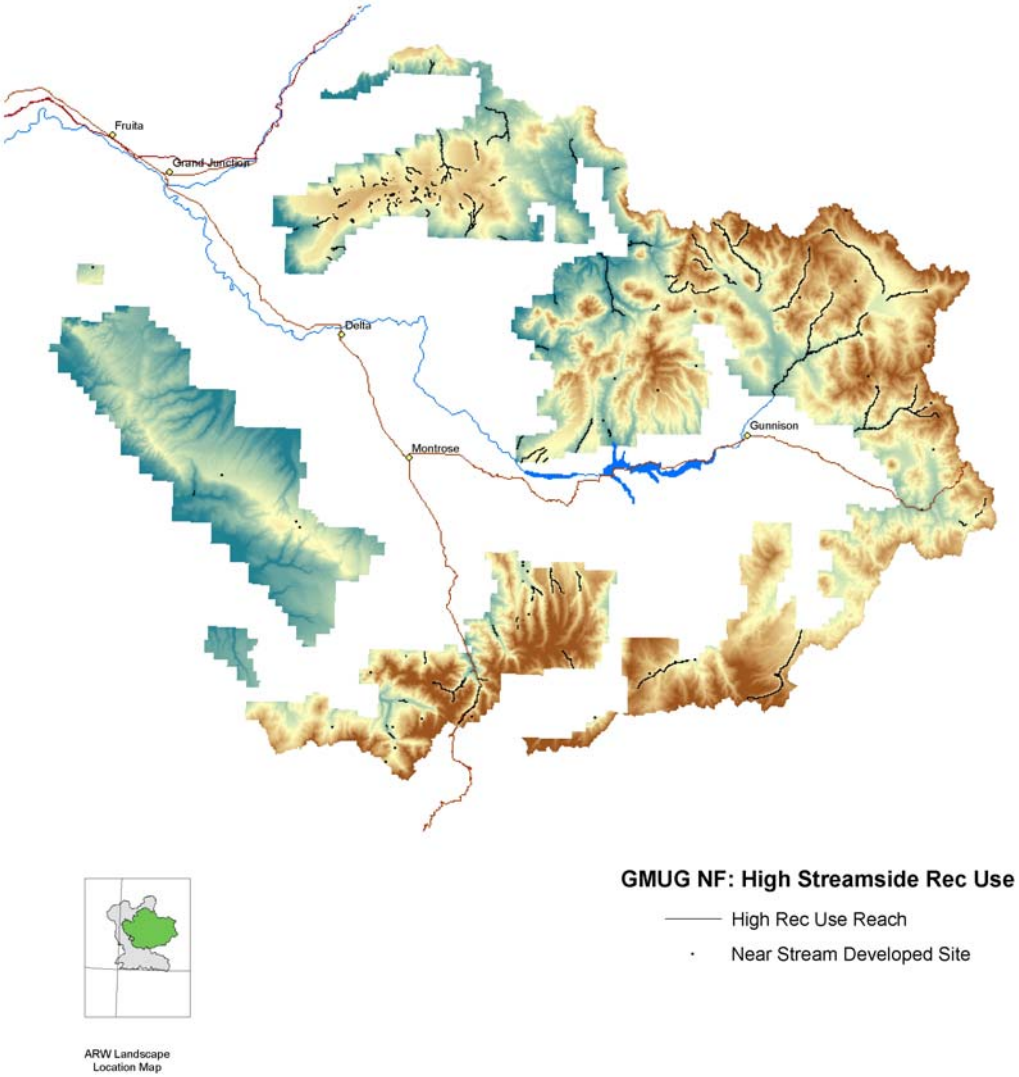
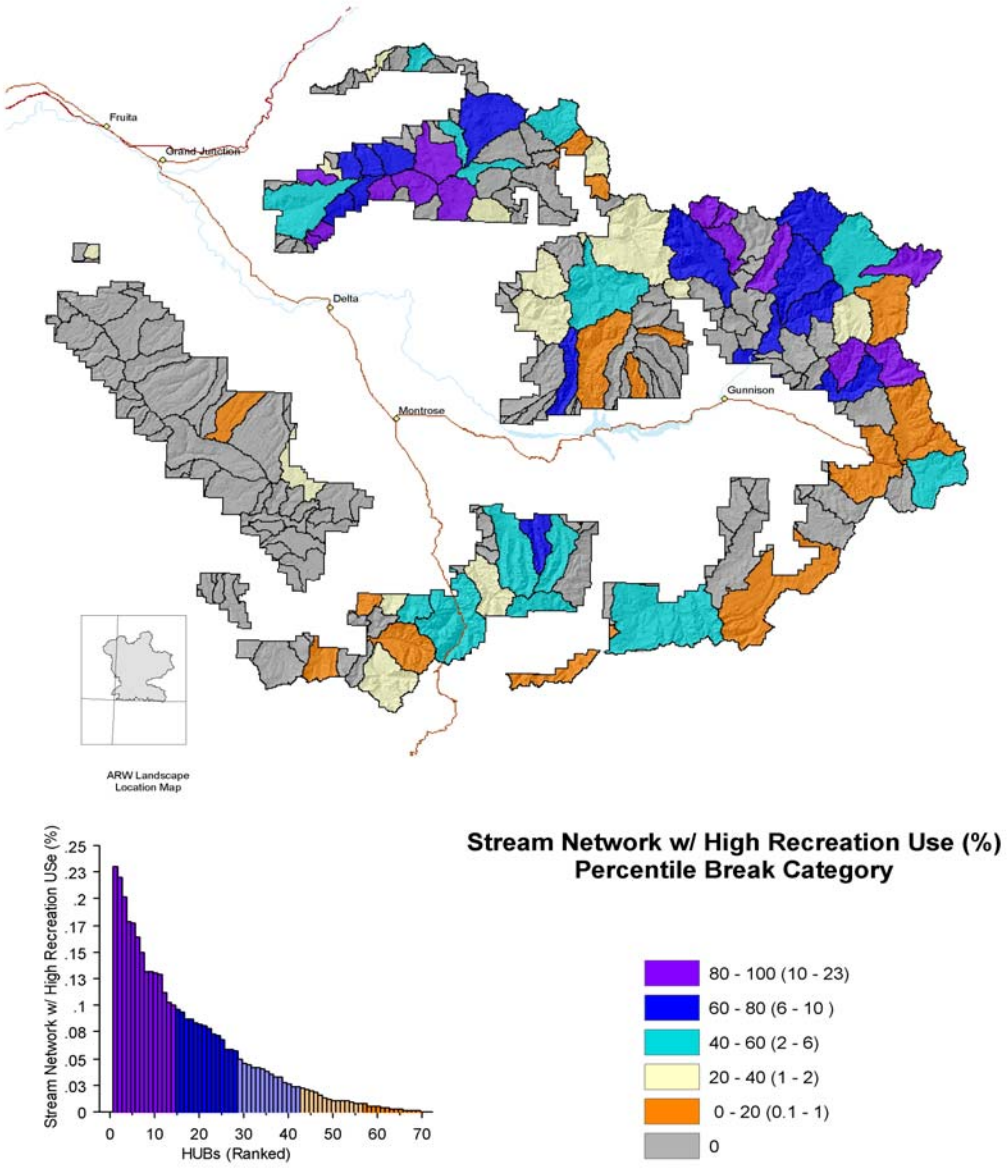


Figure 5C5-2. Rank and Percentage of Stream Network with High Recreational Use.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

Urbanization

Key Findings

1. The extent of private ownership is strongly correlated with historic mining districts and patented claims

2. The potential effects are variable, depend on land owner decisions in terms of use and intensity, and are not within the jurisdiction of the GMUG NFs.

Urban Related Activities and Urban-Type Facilities

The National Forest System (NFS) lands are managed for the public under mandates for multiple use as well as sustained yield, therefore the types of urban related activities and urban-type facilities that can be authorized on NFS lands is somewhat limited in scope. Although, some traditional urbanization activities such as residential housing, industrial development, and municipal facilities do occur on NFS lands, they do not occur at the same density and spatial context associated with towns and cities. The general list of urban-type facilities that occur within the boundaries of the GMUG are roads, trails, water diversion facilities, power transmission lines, water storage facilities, pipelines, telecommunication sites, ski areas, mining facilities, guest lodges, summer residences, and material extraction sites.

These facilities can be located within the National Forest boundaries under different authorities that dictates the level of Forest Service control or management of those urban-type activities. Urban-type facilities that occur on privately owned lands within the National Forest boundaries (e.g., inholdings) are not within the jurisdiction of the Forest Service. Some roads, trails, water storage facilities, ditches, pipelines, and power transmission lines are easements. As easements, there is not a set period or term-of-use authorized. Other urban-type activities and facilities are authorized under special use permits. Generally, all of the above listed urban-type facilities can be authorized as special-use permits or leases. As such, there is a greater degree of Forest Service control and management associated with these activities or facilities. Additionally, these special use permits for facilities or leases on NFS lands have a 20- or 30-year term.

The authorization process is important because it is related to permanency. Privately owned land allows for permanent development of urban-type facilities. Easements also afford a certain degree of permanence. Special-use authorizations and leases can be terminated for a variety of reasons but can also be renewed beyond the initial authorization term. For this reason these urban-type facilities may have less permanency than the other types of urban related activities and facilities.

The exception to all of these authorization conditions is hard-rock (locatable mineral) mining that under the 1872 Mining Law allows for industrial type use and development under a mining claim filed on NFS lands. These facilities or activities are not term limited on the National Forests and can persist until the mineral assets are depleted. Mining claims can be converted to privately owned land provided specific conditions and findings are met.

Urban Influences

The affects of urban-related activities and urban-type facilities vary widely on the aquatic, riparian, and wetland ecosystems depending on the level of use, the spatial context of the area affected, type of activity associated with these activities and facilities and the term of occupancy. The greater the density of the facilities or the greater the level of activity, the more the urban influence on the drainage network, the watershed function, and the stability of the watershed. For the most part, these urban influences are related to effects of permanent or semi-permanent change in vegetation type, loss of the vegetative cover, or creation of impervious surfaces, but many of these effects are indirect consequences of the influences of urban related activities or urban-type facilities. A summary of these effects are:

Hydrology

- Withdrawals from streams for domestic and industrial-type activities alter the hydrologic regimes.
- Increased runoff and reduced infiltration related to the creation of impervious surface conditions associated with urban-type facilities such as parking lots, buildings, roads, and heavily disturbed areas.

Water Quality

- Contamination of surface and groundwater by runoff from parking lots, roads, mined areas, and buildings containing salts, heavy metals, petroleum residues, and other chemicals.
- Increased sediment from disturbed areas and increased runoff that can alter channel stability associated with impervious surfaces or large scale vegetation cover conversions.
- Groundwater contamination from poorly designed or improperly functioning sewage disposal and treatment facilities.

Riparian and Wetland Condition

- Loss or removal of riparian and wetland vegetation from development of urban-type facilities.
- Alteration of stream flow connectivity due to development of urban-type facilities.

- Alteration of existing plant communities relationships can shift livestock and wildlife use causing greater concentrations in riparian corridors.

Channel Condition

- Encroachment of permanent facilities on floodplains and physical alterations of channels by straightening, armoring or installation of culverts and bridges change channel hydrology and response.

- Channel adjustments that occur as a result of encroachment and altered runoff response.

Biotic Condition

- Potential to introduce various pathogens and exotic species due to increased and/or concentrated human activity.

- Increased nutrient inputs from sewage treatment, fertilizer use, and increased impervious surfaces can affect aquatic productivity (e.g., algal blooms).

- Introduction of non-native plant seed sources associated with human related activities such as supplemental livestock feeding, landscape plantings (e.g., Russian olive, Tamarisk) and erosion control revegetation (e.g., Crested wheatgrass).

Evaluation Criteria

While there are numerous urban-related activities and urban-type facilities that influence the aquatic, riparian, and wetland ecosystems on the GMUG, not all of these influences can be tracked or evaluated on a Forest-wide scale. This is due to the lack of data availability or because it is technically difficult to determine the cost-and-effect relationships for some urban influences on aquatic systems. For the purposes of this analysis, the inventory of private lands within the GMUG boundaries was used to characterize urban influence aquatic, riparian, and wetland ecosystems. Private land inholdings were totaled for each 6th level HUC sub-watershed to calculate the percentage of inholdings within the GMUG boundaries.

Other urban influences such as roads, vegetation conversion associated with transmission corridors, water diversions, water storage facilities, mining, and canopy cover removal associated with ski areas have been evaluated under other anthropogenic effects categories in this report. The influences of roads on NFS lands was evaluated under the Transportation Category and looked at such factors as road density, roads within riparian zones, and stream crossings. Vegetation conversions that resulted in canopy cover removal for transmission corridors or in association with ski areas was evaluated under the Vegetation Management Category as equivalent clear-cut acreage. The effects of water diversions and water storage on the aquatic, riparian, and wetland ecosystems were evaluated under the Water Use Category. The number of diversions within a sub-watershed, the miles of stream network below a diversion or storage facility were

determined and those effects were calculated to rate the anthropogenic influence. Mining activities were evaluated under a separate category for mines with the number of mines per sub-watershed being used as the evaluation criteria. Mine totals included known historic and active mining operations.

Using private land inholdings as a measure of urban influence is based on an understanding that as the amount or acreage of inholdings increases there is a greater potential the effects of land-use activities will increase because of greater concentration or frequency of use and that there is a greater likelihood that permanently developed facilities will be located on those private lands as opposed to surrounding NFS lands. While there is no indication that all inholdings are subject to more intense land-use activities or that there are urban-related facilities located on those lands, there exists the potential for use or development that is outside the jurisdiction or control of the Forest Service. Such use and development can occur without regard to GMUG Forest Plan objectives and desired conditions for the surround NFS lands. There is also a greater potential for permanent conversion of forested lands to more urban conditions on inholdings than the surrounding NFS lands. For these reasons, evaluations of urban influences can be measured comparing the percentage of inholdings in each sub-watershed to determine a relative ranking of urban influence on the GMUG.

Forest-wide Summary

This analysis was done for 6th level HUC sub-watersheds calculating the percentage of private land inholdings within the GMUG boundaries. Those sub-watersheds that fall into the highest percentile category (top 20%) in terms of highest percent of private land depicted in Figure 5C6-1. and listed in Table 5C6-1. There are about 202,500 acres of private lands within the GMUG boundaries compared to over 3.1 million acres of NFS lands. This constitutes about six percent of the entire GMUG areas. The sub-watersheds of Upper Uncompahgre River and the Upper San Miguel River (composite) both have the highest acreage totals of private land (15,594 acres and 14,878 acres respectively) within the Forest boundaries. These sub-watersheds have been extensively mined and much of the private land in these areas was titled under provisions of the 1872 Mining Law. There appears to be a strong interrelationship between those sub-watersheds within the high acreage totals of private land inholdings (e.g., Upper San Miguel, Lower Quartz Creek, Upper Uncompahgre River, South Fork of the San Miguel River, Slate Creek, and the Upper Tomichi Creek) and historic mining activity. Although out of top 10 sub-watersheds with the highest percentage of private land ownership only the Upper San Miguel River (composite) experienced significant mining activity that would have created private land inholdings.

The majority (52 percent) of the sub-watersheds within the GMUG fall into the lowest percentile category where the percentage of private land is less than two percent of the sub-watershed area within the GMUG boundaries. There are 118 sub-watersheds within the lowest percentile category and of these, there are 85 where there is no private land within the National Forest boundary.

Figure 5C6-1. Categories of Percent Private Lands by 6th Level HUC Sub-watersheds

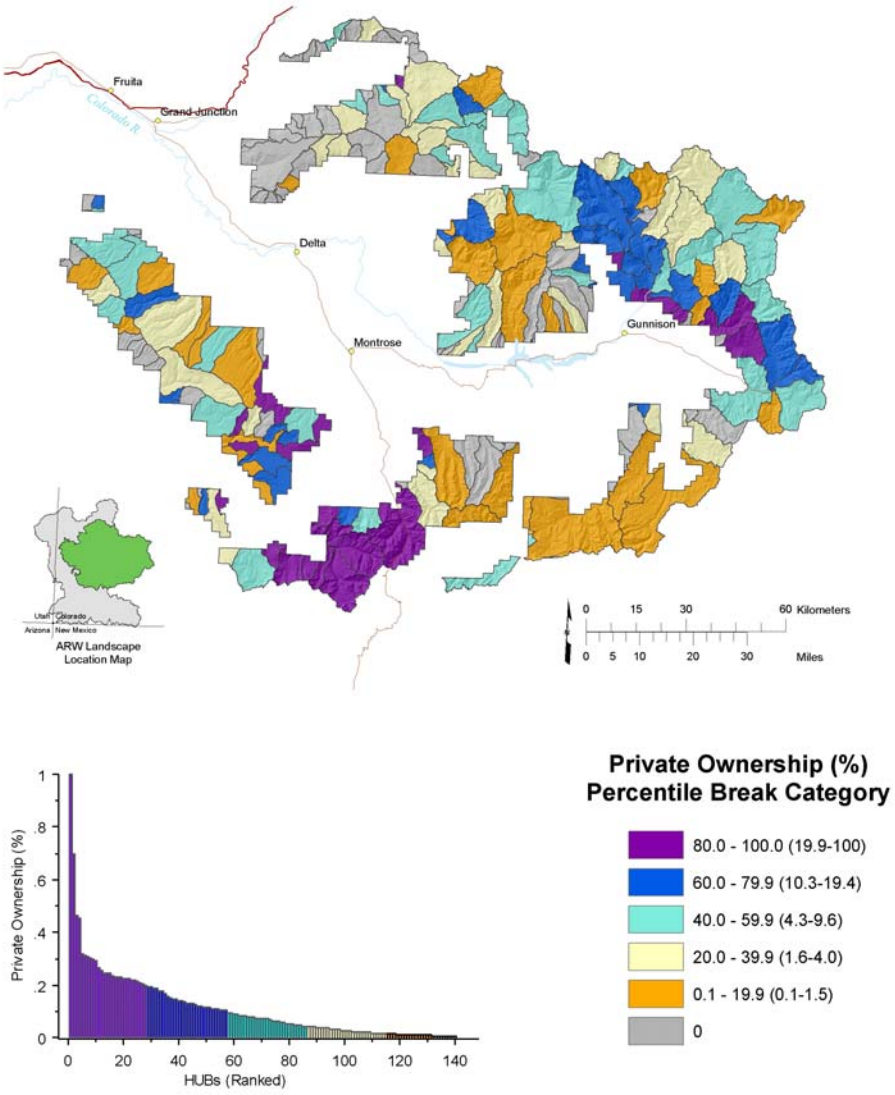


Table 5C6-1. Sub-watersheds in the Highest Percentile Category for Private Lands

Geographic Area	HUC	Watershed	Private Acres	Total Acres	Percent
Uncompahgre	140200064003	Horsefly Creek (eastside)	11	11	100
San Juan	140300034702	Saltado Creek	4,381	6,271	70
Uncompahgre	140300036106	Maverick Draw	1,499	3,236	46
San Juan	140300036303	Upper San Miguel River comp.	14,878	32,669	46
Uncompahgre	140300036508	Albin Draw	1,793	5,659	32
San Juan	140300034703	Specie Creek	327	1,044	31
San Juan	140300036302	Leopard Creek	2,300	7,507	31
San Juan	140200064806	Burro Creek	229	757	30
Uncompahgre	140100051902	Happy Canyon Creek	588	1,986	29
Gunnison	140200020102	Willow Creek	865	3,229	27
Gunnison	140200039301	Lower Quartz Creek	6,284	24,534	26
Uncompahgre	140300036502	Sheep Creek	1,095	4,431	25
San Juan	140200067901	Upper Uncompahgre River	15,594	63,451	25
Gunnison	140200025401	Gunnison River comp.	1,367	5,632	24
San Juan	140300036308	Fall Creek	4,018	17,232	23
Uncompahgre	140300036308	Upper Horsefly Creek (Westside)	2,205	9,539	23
Gunnison	140200025402	Leaps Gulch	1,349	5,852	23
San Juan	140300036304	South Fork San Miguel River	8,484	37,144	23
San Juan	140300036307	Bear Creek	1,444	6,431	22
Uncompahgre	140200065001	East Fork Dry Creek	3,663	16,385	22
San Juan	140300036305	Deep Creek	2,021	9,079	22
San Juan	140200064805	Deer Creek	188	855	22
San Juan	140200064804	Lou Creek	1,153	5,263	22
San Juan	140300036306	Bilk Creek	1,726	8,095	21
Gunnison	140200038905	Cabin Creek	790	3,823	21
Gunnison	140200038902	Hot Spring Creek	4,302	21,241	20
San Juan	140300036301	Middle San Miguel River comp.	723	3,636	20

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Activities – Anthropogenic Influences

Mineral Extraction

Key Findings

1. Approximately 43.4 miles of stream within the GMUG are listed by the State of Colorado as impaired waters due to water quality impacts due to historic mining activities. All impaired segments are within the 4 sub-watersheds with the highest density of AML sites.
2. A total of 63 sub-watersheds include abandoned mine land (AML) sites.
3. The surface water quality and aquatic habitat effects vary widely between sites.

Influences of Mineral Extraction

A complete description of the influence of mineral extraction on aquatic, riparian and wetland ecosystems is provided in Winters et al., 2003, vers. 1.0).

The following is a summary of potential direct effects due to mineral extraction:

Hydrology

- Interception of groundwater and rerouting to surface streams
- Consumptive use associated with operations.
- Runoff increases and base flow decreases due to reduced percolation as a result of increased area of impervious surfaces.

Water Quality

- Surface and groundwater contamination from acid runoff, dissolved metals, and sediment production.
- Toxic metal adsorbtion to stream channel sediments.

Wetlands and riparian areas

- Direct loss due to operations.
- Changes in structure and function due to water contamination.
- Losses due to groundwater interception.

Uplands

- Reduction in site productivity due to detrimental soil impacts (erosion, compaction, top soil loss).

Channel conditions

- Physical channel modifications (relocation, ditching, damming, etc.).
- Changes to channels or substrate composition due to groundwater interception.
- Substrate composition due surface erosion or tailings failures.

Biotic Conditions

- Loss of productivity/biomass, changes in composition, and reproduction due to surface and groundwater contamination.
- Loss of sensitive species (amphibians, mayflies).
- Alteration of primary productivity and fish or macro-invertebrates communities due to sedimentation.

Management Scale

Forest-wide Summary

There are approximately 918 separate mineral development sites identified within the GMUG (USGS, 1997). Nearly two thirds are categorized as historic (Table 5C7-1), while less than 2 percent are considered active (recent). The preponderance of those classified as unknown are also likely to be historic. Presently there are 21 natural gas wells capable of production.

Table 5C7-1. Mine Site Status within GMUG Boundary.

Status	Number of Sites	Percent
Historic	600	65.3%
Prospect	38	4.1%
Recent	13	1.4%
Unknown	267	29.4%
	918	100.0%

As a consequence, the current impacts of mining across the GMUG are largely related to the historic development of locatable minerals. Precious and base metals occur primarily in Tertiary intrusive and extrusive rocks in a variety of ore types (Nash, 2002). Notable areas of concentrated activity occurred in the southern San Juan vicinity, locations north & west of Crested Butte, and in the Quartz Creek & Tincup areas east of Gunnison. The effects on surface water quality and aquatic habitat vary widely from site to site, largely due to the nature of the host rock surrounding the ore bodies (Nash, 2002). Additional detailed discussion is available in both Nash, 2002 and Bankey, 2004.

The State of Colorado has identified 11 stream segments totaling approximately 43.4 miles within the GMUG boundaries, that do not meet water quality standards due to metal concentrations related to historic mining activities (Table 5C7-2 and Figure 5C7-2). These streams are identified on the State's Clean Water Act Section 303(d) list, and require Total Maximum Daily Load (TMDL) determinations for each pollutant. Currently they are all considered high or moderate priority by the State for TMDL development.

Table 5C7-2. State of Colorado 303d listed stream segments within GMUG Boundary.

Segment ID	Segment Description	Parameter	Miles
COGUSM03a	San Miguel River, Bridal Veil & Ingram Cks to Marshall Ck	Zn	0.4
COGUSM03b	San Miguel River, Marshall Ck to S Fk San Miguel	Zn	7.6
COGUSM06a	Ingram Ck, source to San Miguel River	Zn	2.1
COGUSM06b	Marshall Ck, source to San Miguel River	Zn	1.5
COGUUG10	Oh-Be-Joyful Ck, from wilderness to Slate River	Cd,Zn	1.2
COGUUG11	Coal Ck from Elk Ck to CB intake, plus Elk Ck	Cd, Pb, Zn	4.8
COGUUG12	Coal Ck and tributaries from CB intake to Slate River	Zn	0.9
COGUUN02	Uncompahgre River, source to Red Mountain Ck	Cu, Zn	7.5
COGUUN03	Uncompahgre River, Red Mountain Ck to Montrose	Cu, Fe, Zn	2.9
COGUUN06b	Red Mountain Creek from E Fk Red Mtn Ck to Uncompahgre R	Cd, Pb, Zn	5.8
COGUUN09	Canyon, Imogene, Sneffles Creeks	Zn	8.5

The GMUG, in cooperation with the State of Colorado, completed an inventory of abandoned mine lands (AML) in the mid 1990s (Fehlman, unpbl). That inventory, which located and described potential physical and environmental risks, cataloged nearly 2,900 adits and nearly 2,000 tailings piles forest-wide and is the basis for assessing mining related risks to aquatic systems (Figure 5C7-1).

Watershed-Scale Summary

The density of AML sites (adits + tailings) by 6th level HUC sub-watershed was used to evaluate the mineral extraction related risks to aquatic resources.

Watershed influence measure:

- Total AML site density ((adits tailings)/mi^2 in HUC)

Watershed Influences

AML Site Density

Across the GMUG , 63 6th level HUC sub-watersheds include AML sites. The AML site density ranges from 0.01 / mi2 to 12 / mi2. The highest ranked sub-watersheds (top 20%) are listed in Table 5C7-3, and the geographic distribution of all percentile groups is portrayed in Figure 5C7-2. All the 303d listed stream segments lie within 3 of the 4 highest AML density sub-watersheds (Upper Uncompahgre R., Slate R., and the Upper San Miguel R).

Figure 5C7-1. Forest-wide distribution of abandoned mine land (AML) sites.

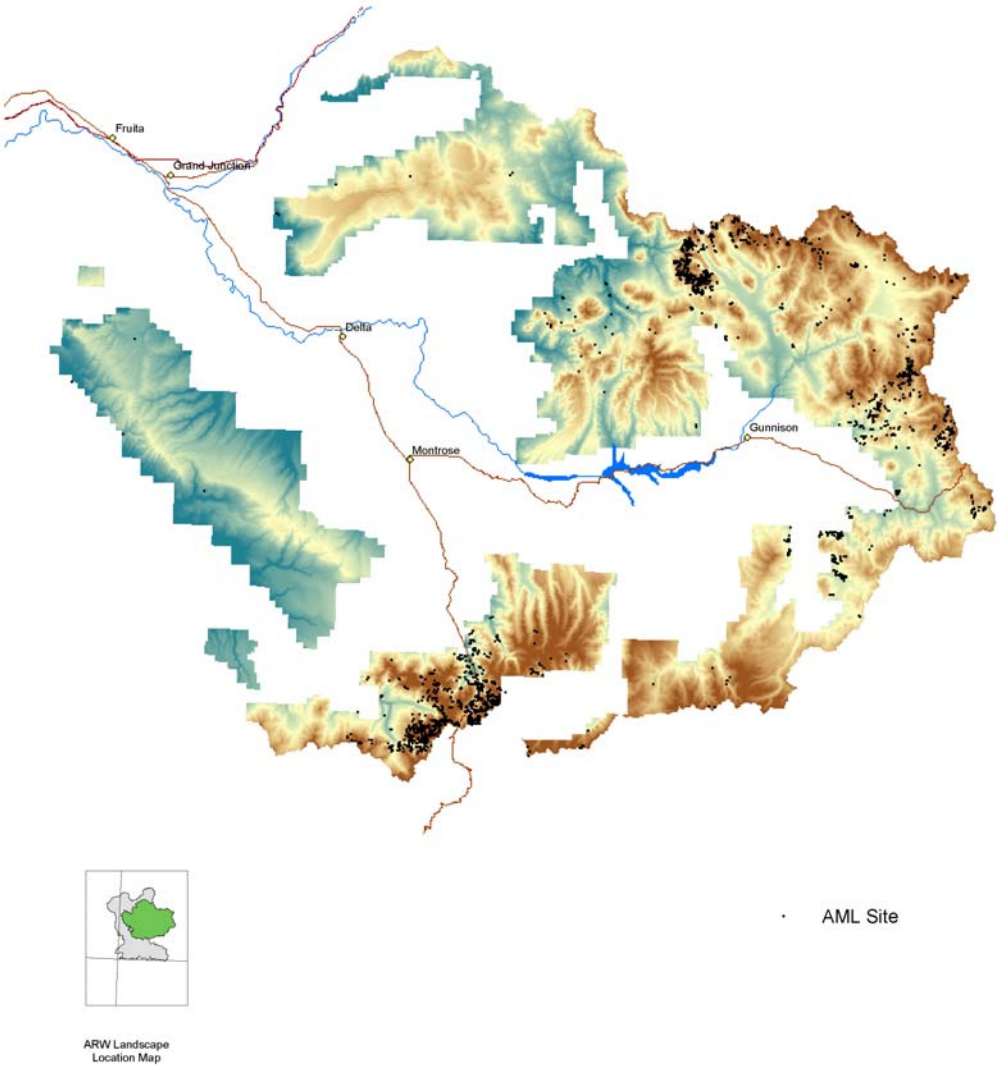


Figure 5C7-2. AML site density with percentile ranking across the GMUG and State of Colorado 303d Listed Stream Segments.

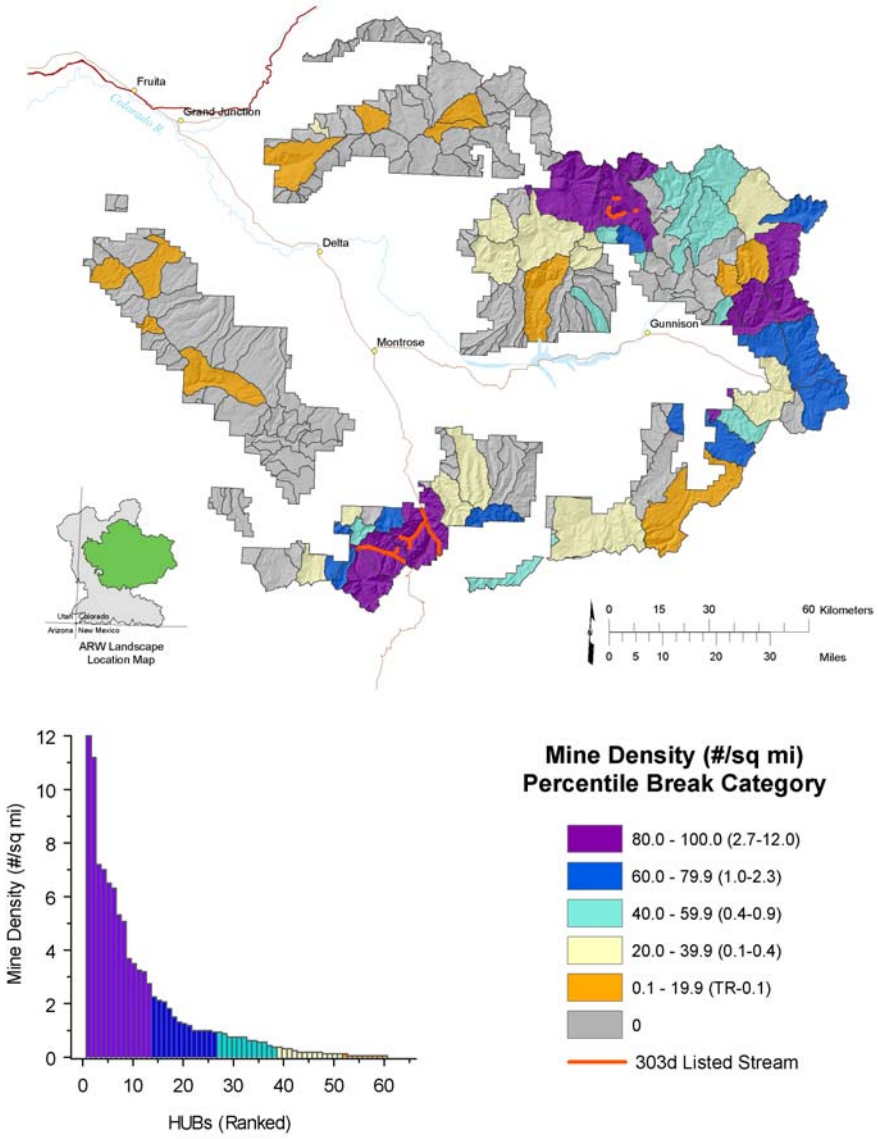


Table 5C7-3. Top 20th Percentile Sub-watersheds (AML sites/mi2).

HUC6_NAME	HUC6	MINE DENSITY	% NF	NF Acres
Upper Uncompahgre Rvr	140200067901	12.0	73	63,451
Slate Rvr	140200019908	11.2	79	45,688
Upper East Rvr	140200019910	7.2	100	11,334
Upper San Miguel Rvr	140300036303	7.0	100	32,669
Copper Ck	140200019909	6.5	100	5,886
Prosser Ck	140200035102	6.3	57	2,547
South Fk San Miguel Rvr	140300036304	5.3	100	37,144
Gold Ck	140200039303	5.0	100	19,457
Willow Ck	140200019507	3.7	100	40,620
Lower Razor Ck C	140200035103	3.5	9	1,270
Lower Quartz Ck C	140200039301	3.3	79	24,534
Upper Quartz Ck	140200039304	3.2	100	25,919
Anthracite Ck	140200040701	2.7	95	80,009
Upper Tomichi Ck	140200039103	2.3	100	58,230
West Pass Ck	140200038703	2.2	89	27,621
Bilk Ck	140300036306	2.1	89	8,095
Lower Cochetopa Ck C	140200038704	1.8	18	10,562
Wood Gulch	140200038903	1.5	29	2,163
Bear Ck	140300036307	1.3	62	6,431
Mid San Miguel Rvr C	140300036301	1.2	17	3,636

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Hydrologic Integrity

The concept of 'ecosystem health' is intuitively appealing because it simplifies a complex set of interacting components into a notion analogous to human health, which is familiar to everyone (Karr and Chu, 1999; Lackey, 2001). Although conceptually useful, there is no consensus regarding the definition of ecosystem health or the related concept of integrity, which some consider equivalent and others distinct terms (Lackey, 2001). The differing views are largely a result of whether or not 'ecosystem health' reflects some human oriented value. The lack of widely accepted definitions precludes direct quantification or measurement, which is consistent with the assertion that ecosystem health and integrity are not inherent properties of ecosystems (Wicklum & Davis, 1995).

This evaluation of hydrologic integrity is based on the premise that a high degree of integrity is defined by an absence or limited amount of human activity (Karr and Chu, 1999). Watersheds with high integrity limit the magnitude and effects of erosion and sedimentation (Quigley, 1996), and are functioning within the long-term range of historic variability. Watershed changes or impacts that alter natural processes or watershed components result in diminished watershed integrity. In extreme cases, hydrologic integrity can be reduced to a point were there is complete or substantial loss of natural function (e.g., fully urbanized watersheds), and are outside their range of historic variability.

The previously discussed physical sensitivity and management activity results were combined to characterize hydrologic integrity for the GMUG. The derived ratings and classes are not absolute values nor is there a basis available to define thresholds for acceptable or unacceptable ratings. The results allow for relative comparison of condition and trend, suggesting the likelihood of systems being within the historic range of variation. Low integrity ratings do not imply the entire sub-watershed or stream network is in poor condition, but rather where local upland, riparian, or stream reach level degradation is more likely.

The full range of human or management activities are not represented across the GMUG. Absent are widespread vegetative type conversions to agricultural or urban uses, fertilizer, pesticide or feedlot runoff, channel straightening & hardening, and industrial or municipal pollutant discharge. Consequently, only a portion of all possible hydrologic integrity ratings is represented by the results.

A key product of the analysis is the classification or categorization of all the sub-watersheds into classes based on overall integrity, in order to facilitate various interpretations.

Key Findings

- Overall results suggest a range of on-the-ground conditions from full natural function to the likelihood of site-specific or stream segment (reach) impacts.
- Sub-watersheds with the highest relative integrity (class 1) are assumed to be functioning within the expected range of natural variability. They comprise about 30 percent of the GMUG and include areas with no or little land use activities across all physical sensitivity classes.
- Some sub-watersheds with high physical sensitivity have high relative integrity (class 1), due to the lack of land-use activity. Therefore, they may have less capacity to absorb land-use activities than those with low sensitivity (less resilient).
- The distribution of relative integrity ratings is heavily weighted in the two highest classes (classes 1 and 2). Almost 75% of the sub-watersheds are in these two classes (Figure 5D-2), and account for about 70 percent of the GMUG area.
- Sub-watersheds with the lowest relative integrity (class 4) have high cumulative activity levels and moderate to high physical sensitivity, or a high level of a single activity.

Results

Based on the various variables and methods used (described in sections 5A – 5C) the highest numerical hydrologic integrity product is 35.0 (which would reflect the lowest relative integrity). That would represent a sub-watershed with the highest value for all 5 sensitivity and 7 management activity variables. The actual distribution of calculated products across the GMUG range from 0.0 to 4.4, which is illustrated in Figure 5D-1 along with the 'Jenk' class breaks.

The 'box and whisker' diagram of Figure 5D-2 (previously described in 5B.1 and 5C.1) illustrates the individual rating class ranges and separation between them. Rating class 3 has the greatest with-in class variability.

The data used to estimate hydrologic integrity ratings on GMUG lands is not consistently available at the landscape or regional scales. Nor as previously suggested, does the full spectrum of land uses or activities occur on the GMUG. An analysis of entire sub-watersheds, including intensive land uses, would provide context for these GMUG based results. Never the less, ratings for GMUG lands with no or limited management activities would remain at the "higher integrity" end of the results. It is also likely, that the GMUG portion of sub-watersheds with lower relative ratings would not be at the lowest extreme given the lack of more intensive land uses on the GMUG.

A much broader scale evaluation, which considered the affects of more intensive activities, characterized the sub-basins (HUC4s) that include the GMUG as having 'Better Water Quality and Low Vulnerability' (U.S. EPA, 1999).

Integrity Class 1

These sub-watersheds have the highest relative integrity and are functioning in a near natural state with minimal anthropogenic influence. About 40 percent of the sub-watersheds on the GMUG are included, accounting for about 30 percent of the total GMUG area (Figure 5D-3). Sub-watersheds in this class include those with no or limited activity levels across all sensitivity classes. Those that have high physical sensitivity may not have the capacity to absorb increased land-use activity without diminishing hydrologic integrity (Table 5D-1).

Sub-watersheds with little or no anthropogenic influences, regardless of inherent physical sensitivity, could serve as reference or benchmark to evaluate the effects of land-use activities. It is valuable to maintain reference watersheds with varying levels of physical sensitivity to provide a full spectrum of hydrologic conditions and function for comparison and study. There are other factors or considerations besides this first level evaluation of potential reference watersheds that must be taken into account to better define these desired water resource management objectives for the GMUG. Watershed values, both ecological and social, watershed size and ownership patterns as well as eco-regional characterizations and differences all play a part in defining reference or benchmark watershed objectives.

Integrity Class 2

About 35 percent of the sub-watersheds fall into this integrity class (Figure 5D-3) and comprise just over 40 percent of the GMUG area. Activities have altered natural conditions to some extent, but most likely processes remain in the range of historic variability.

These sub-watersheds generally have moderate activity levels coupled with low to moderate physical sensitivity levels. It is important to evaluate existing or historic activities to ensure that additional activities do not impair aquatic and terrestrial systems. The implementation of appropriate and applicable BMPs with all land-use activities is integral to Forest Service management on the GMUG.

Integrity Class 3

About 15 percent of the sub-watersheds fall into this integrity class (Figure 5D-3) and comprise just over 17 percent of the GMUG area. This group of sub-watersheds has moderate or higher activity levels coupled with moderate to high sensitivity. While these watersheds may have diminished levels of natural function, they are not impaired and beneficial uses are sustained. There is a greater potential to find stream segments or specific areas within the watershed that are not functioning properly. Watersheds with integrity ratings that fall into the two middle categories (Classes 2 and 3) have combinations of factors that lessen their relative integrity either due to increased activity or physical sensitivity totals, or both.

Additional land-use activities must be carefully weighed and evaluated to determine their influence and potential effects so they do not degrade or impair specific areas or

segments of the drainage network. More restrictive management controls may be warranted for any additional land-use activities. Finally, existing land uses should be also examined to determine if there is potential for remedial actions to lessen any detrimental effects.

Integrity Class 4

Twenty-three or slightly more 10% of the sub-watersheds are in this class, which comprise about 12 percent of the GMUG area. In 9 of those (representing 8% of the GMUG area) the cumulative affects of two or three activities occur at relatively high levels in conjunction with high physical sensitivity (Table 5D-2). For the remainder, the initial calculated classification was adjusted to the lowest relative class based on the presence of a single high intensity activity. Those activities affect function either as high-intensity, short-term impacts, or as a long-term alteration of the hydrologic regime. Those activities are identified in section 5C – ACTIVITIES.

As a relative rating the results do not imply that the entire sub-watershed is impaired or unstable. However, they do have the greatest likelihood of specific degraded stream segments with some impairment of beneficial use, or unstable conditions that are adversely affecting aquatic conditions. Such is the case with the three sub-watersheds containing stream segments on the 2004 State of Colorado 303d list of impaired waters due to heavy metal contamination.

These integrity ratings indicate that due to the combination of sensitivity and activity influences there is a greater potential to have site specific or stream segment problems, suggesting the need for more intensive stream surveys, watershed inventories, or monitoring. These finer scale evaluations may have to occur as part of project level planning or may be the basis for forest-wide watershed program priorities. Ultimately, the objective of the more intensive evaluations would be to determine the extent, location, and level of effect that land-use activities are having on the stream network or how they are affecting watershed function.

These are the sub-watersheds where the water resource management objectives may be more focused on restoration or remediation type actions, although sub-watershed wide restoration of historic mining impacts may be beyond the scope of the GMUG water resources program because of private land in-holdings and other federal agency regulatory authorities. Similarly, where water diversions are the primary management activity there may be limited potential for restoration since the beneficial use of decreed water rights is a recognized suitable use on NFS lands.

Figure 5D-1. Distribution of 6th Level HUC Watershed Integrity Ratings

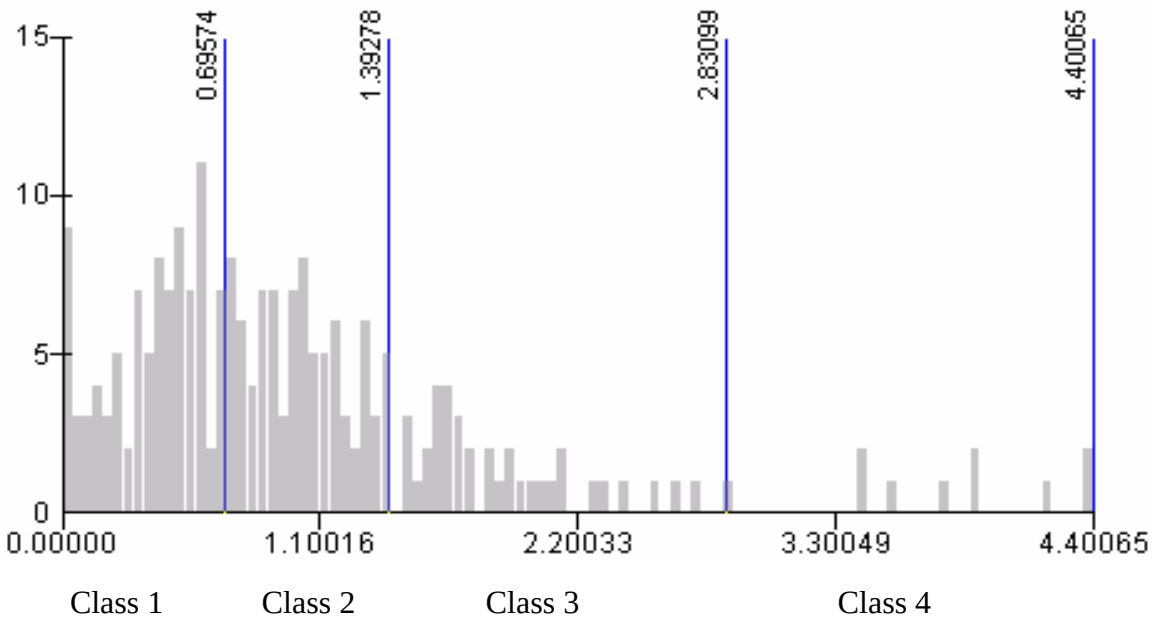


Figure 5D-2. 'Box and Whisker' diagram of physical hydrologic integrity classification.

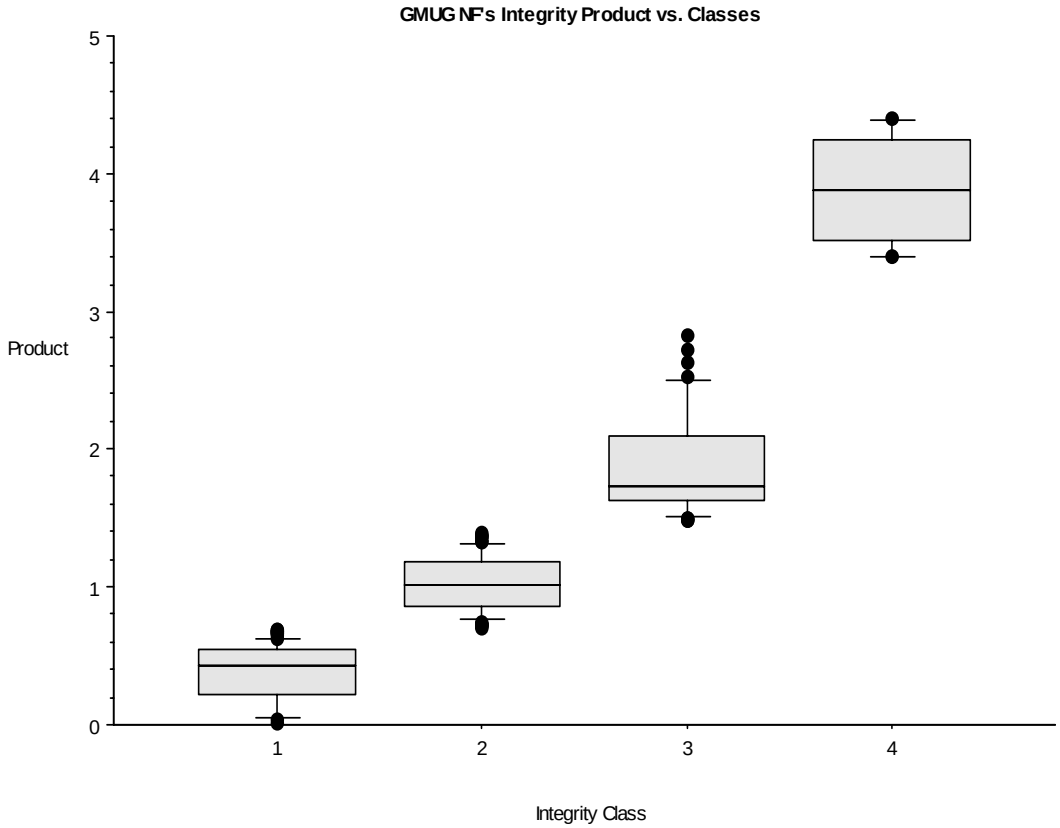


Figure 5D-3. GMUG NFs Sub-Watershed Integrity Classes

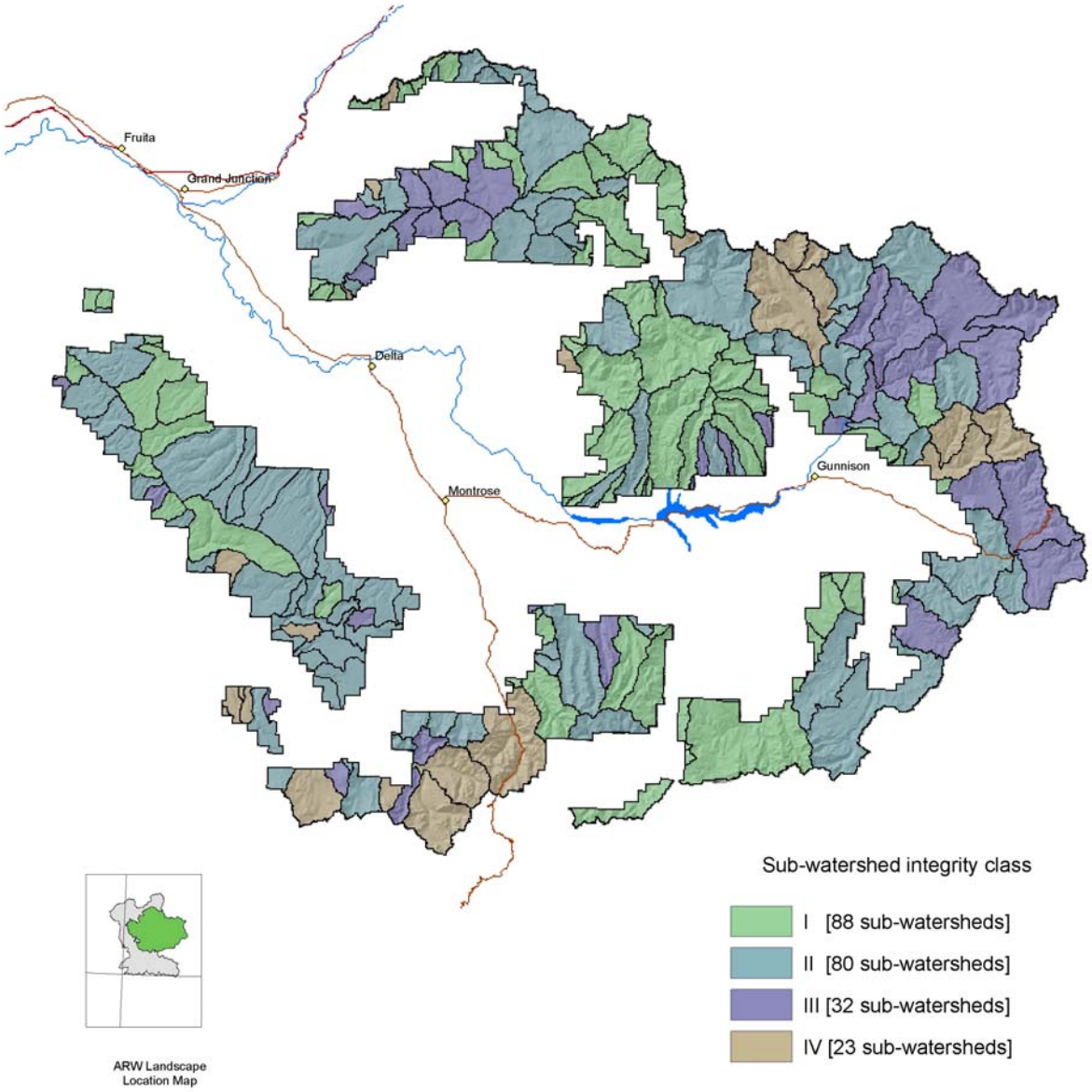


Table 5D-1. High Hydrologic Integrity Sub-Watersheds with High Physical Sensitivity Totals.

Geographic Area	HUC6	Sub-watershed Name	Physical Sensitivity Total	Hydrologic Integrity Product	Percent NFS land
Grand Mesa	140100051701	Lower Plateau Comp.	2.98	0.32	10
San Juan	140200064801	Upper Cow Creek	2.51	0.42	89
Uncompahgre	140300046903	Wright/Castro Draws	2.48	0.04	1
Gunnison	140200020302	West Elk Creek	2.23	0.07	97
Uncompahgre	140300036703	Campbell Creek	2.17	0.37	41
Gunnison	140200028303	Upper Lake Fork	2.15	0.60	41
Gunnison	140200024901	Big Blue	2.11	0.60	76
Grand Mesa	140100051706	Park Creek	2.10	0.69	91
Grand Mesa	140100051703	Kimball Creek	2.05	0.56	66
Gunnison	140200020106	Castle Creek	2.00	0.23	97
Gunnison	140200020301	Soap Creek	1.98	0.43	98
Gunnison	140200020310	Beaver Creek	1.98	0.09	75

Table 5D-2 Low Hydrologic Integrity Sub-Watersheds

Geographic Area	HUC6	Sub-Watershed Name	Physical Sensitivity Total	Activity Total	Hydrologic Integrity Product	Group
San Juan	140200067901	Upper Uncompahgre River	2.59 (4)	1.70 (4)	4.40	4
Gunnison	140200019909	Copper Creek	2.27 (4)	1.93 (4)	4.37	4
Gunnison	140200019907	Middle East River Comp.	2.78 (4)	1.51 (4)	4.20	4
Gunnison	140200019908	Slate River	2.03 (4)	1.92 (4)	3.90	4
Gunnison	140200039304	Upper Quartz Creek	2.29 (4)	1.70 (4)	3.89	4
Gunnison	140200019910	Upper East River	2.47 (4)	1.53 (4)	3.78	4
Gunnison	140200039301	Lower Quartz Creek Comp.	2.25 (4)	1.58 (4)	3.55	4
San Juan	140300036303	Upper San Miguel River C.	2.19 (4)	1.56 (4)	3.42	4
Gunnison	140200039303	Gold Creek	2.03 (4)	1.67 (4)	3.39	4
San Juan	140300036304	South Fork San Miguel R.	2.09 (4)	1.35 (4)	2.83*	4
Uncompahgre	140300036102	Mckee Draw	1.21 (2)	1.89 (4)	2.29*	4
Uncompahgre	140300036508	Albin Draw	1.56 (3)	1.04 (4)*	1.63*	4
Uncompahgre	140300036307	Bear Creek	1.52 (3)	1.06 (4)*	1.61*	4
Uncompahgre	140300036105	Hamilton Creek	1.09 (2)	1.45 (4)	1.58*	4
Uncompahgre	140300034502	Bucktail Creeks Comp.	1.28 (2)	1.04 (4)*	1.34*	4
Uncompahgre	140300036103	Burn Canyon	0.99 (1)	1.27 (4)	1.25*	4
Uncompahgre	140300034701	Beaver Creek	1.48 (3)	0.75 (4)*	1.11*	4
Grand Mesa	140200051301	Dry Gulch	0.92 (1)	1.19 (4)*	1.09*	4
Uncompahgre	140300036104	Callan Draw	1.42 (2)	0.74 (4)*	1.05*	4
Grand Mesa	140100051714	Spring Creek	0.97 (1)	0.58 (4)*	0.57*	4
North Fork	140200041104	Paonia Reservoir Comp.	1.67 (3)	0.32 (4)*	0.53*	4
Grand Mesa	140100051702	Anderson Gulch	2.94 (4)	0.16 (4)*	0.47*	4
North Fork	140200045807	Cottonwood Creek	1.09 (2)	0.38 (4)*	0.41*	4

* Denotes Special Circumstance activities that adjust the Activity Total or Product into Group 4.

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Values

Human perspectives and ecological processes determine watershed values. In general, properly functioning watersheds will provide for more values to be realized than those that are degraded or impaired. The State of Colorado has identified a number of designated use classes (both social and ecological), and established water quality guidance to protect them. Ecological values at times may be in conflict with human or social values. An example would be a stream that has a substantial portion of its natural flow diverted for commercial or domestic needs. These diversions provide substantial human value in terms of agricultural production and sustaining people's daily lives, yet they can reduce the habitat quality for aquatic species, or other ecologically related processes such as groundwater recharge or sustaining water dependent vegetative communities. Management of water resources on NFS lands must balance these competing needs and values.

Some values are easily quantified, while others can only be described or perceived and are difficult to objectively quantify. Aesthetics, a sense of place, and solitude are social values that are not easily quantified, while others can be counted or measured such as riparian areas, fish, recreational opportunities, water yield and usage, presence of or habitat for Threatened and Endangered species, and productive aquatic habitat. Additionally, there are values that watersheds provide in terms of downstream or out of channel benefits such as surface and ground water for municipal or domestic supply, industry, and agriculture.

Evaluation Criteria

A number of social and ecological values were characterized based on data that was available Forest-wide and could be expressed in some recognized unit of measure. Unlike evaluations of overall physical sensitivity or activity levels, determining an index for overall values is problematic due to the contradictory relation between some social ecological values. The values examined were characterized largely in terms of total amounts occurring by sub-watershed or their presence or absence.

Ecological Values	**Unit of Measure**
Aquatic Threatened, Endangered or Sensitive Species (TES)	Presence/absence
Botanical (water dependant) TES	Presence/absence
Water yield	Inches of Runoff
Riparian Cottonwood stands	Stream miles
Adjustable Channels (potentially high value aquatic habitat)	Stream miles
Riparian areas and wetlands	Acres
Special Water-dependant Plant Communities	Number

Social Values	**Unit of Measure**
Public Water Supplies	Percent of Source Area on GMUG
General Recreation	Stream miles
Recreational Fishing	Stream miles
Water Uses	Ac-ft withdrawn/diverted

Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Aquatic Threatened, Endangered or Sensitive Species

Colorado River Cutthroat Trout

Introduction

Colorado River cutthroat trout - CRCT **(*Oncorhynchus clarki pleuriticus*)** historically occupied portions of the Colorado River drainage in Wyoming, Colorado, Utah, Arizona, and New Mexico (Behnke 1992). Today the species is believed to occupy less than 5% of its historic range and is often isolated in small headwater streams. Colorado River cutthroat trout is classified as sensitive by the Rocky Mountain Region of the Forest Service, and a species of concern by the State of Colorado.

Management Status

An assessment detailing the status of CRCT populations and habitat was completed in 2001 by various state and Federal agencies. The document entitled, ***The Conservation Agreement for Colorado River Cutthroat Trout in the States of Colorado, Utah, and Wyoming (CAS)*** provides a comprehensive and strategic plan for maintaining the viability of CRCT across the species natural range. The CAS identifies population and habitat objectives for 15 Geographic Management Units (GMU) across the historic range of CRCT.

Most CRCT conservation populations in the Colorado, Dolores and Gunnison GMU are small (< 500 adult fish), and restricted to isolated headwater reaches (Table 5E2-1). Only two meta-populations are suspected to exist, one each in the Colorado and Gunnison GMU. Of these two, only one occurs on the GMUG in the Upper Muddy Creek sub-watershed on the Paonia Ranger District. However, more recent data suggests that the upper Muddy Creek populations may not meet the meta-population definition in the CAS (five connected subpopulations). Further evaluation should be conducted to determine the status of these populations.

Table 5E2-1. Frequency of CRCT Conservation populations with adult abundance (>150mm) and the number of identified meta-populations in GMU with GMUG administered lands (2003).

	Abundance of CRCT populations				Number of meta-populations (5 or more)	Number of meta-populations (2-4)
GMU	0-100	101-499	500-999	>1000		
Colorado	18	32	16	8	1	3
Dolores	2	1	0	0	0	0
Gunnison	2	5	3	1	1	2

Conservation populations known to occur in 25 7th level HUCs on the GMUG are illustrated in Figure 5E2-1. Two additional populations exist on BLM lands adjacent to the Forest. Streams on the Forest support 27% of the known CRCT Conservation Populations in the Colorado, Dolores and Gunnison GMUs. Conservation Populations are limited to isolated headwater streams ranging from 2 to 4 miles in length (approximately 75 total miles) and remain at risk for localized extirpations, with most populations occurring in tributaries of the North Fork of the Gunnison River. The miles of stream occupied by CRCT on the Forest has increased 29% since 2001. However, this increase is largely due to the discovery of new CRCT Conservation Populations, and not from increases in abundance or dispersal of individual populations.

Two CRCT Conservation Populations have been established in lakes totaling approximately 75 surface acres on the Grand Mesa; however, severe drought and dam reconstruction have likely resulted in the loss of these populations.

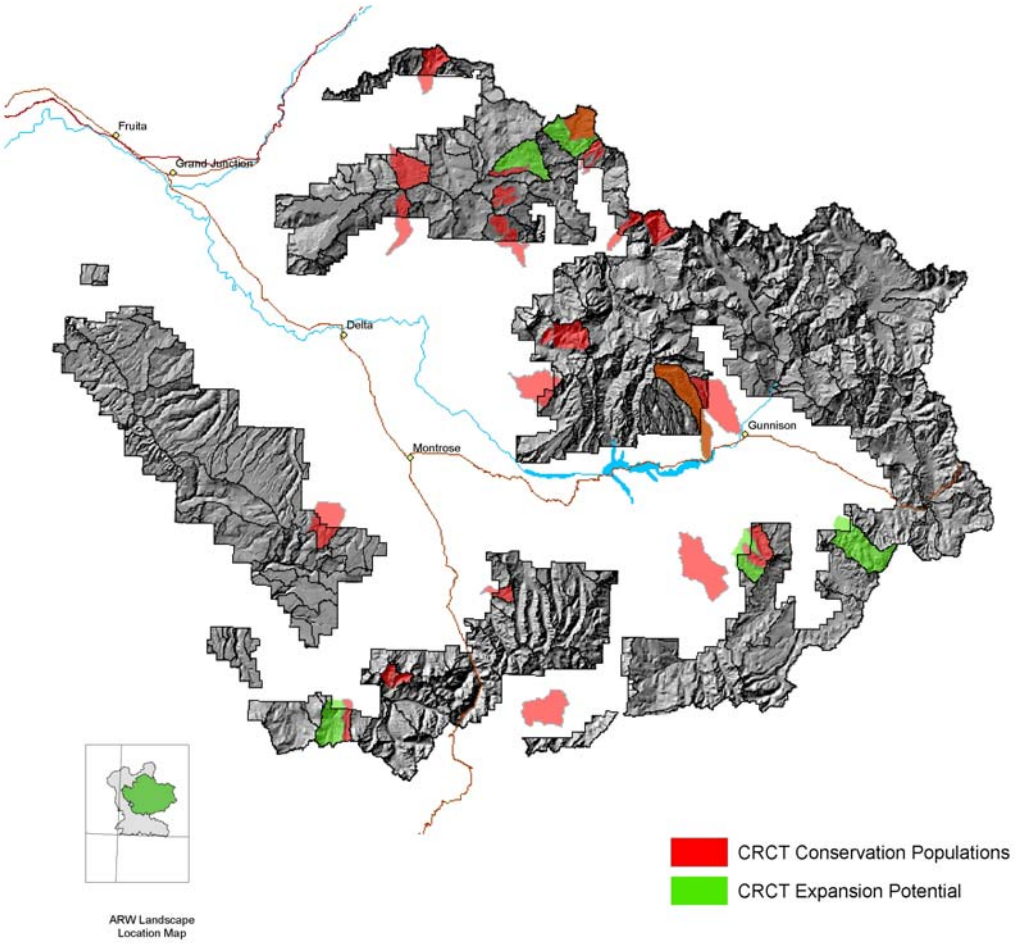
Expansion Potential

Population and distribution goals and objectives described in the CAS have not been attained in the Colorado, Dolores or Gunnison GMUs. The GMUG is a key player in attainment of these goals, particularly in providing high quality habitat and in re-establishment of meta-populations in cooperation with CDOW. CDOW and Forest Service biologists have identified several streams with CRCT population expansion potential (Table 5E2-2). Those streams where expansion is technically feasible include 6th (sub-watersheds) and 7th level HUC catchments (Figure 5E2-2). All six potential expansion areas are in watershed integrity Class I or II. Five of the proposed catchments are in the Gunnison GMU and one (Fall and Elk Creeks) occurs in the Dolores GMU. The list of potential expansion sites is subject to revision based upon new or revised information

Table 5E2-2. Potentially sites suitable for establishment of CRCT meta-populations on the GMUG.

Stream Name	Catchment HUC Code	Watershed Integrity Class
Fall Creek, Elk Creek, and Woods Lake.	14030003630802 14030003630803	II
Clear Fork Muddy Creek including Trail Gulch and Rock Creeks	14020004090301 14020004090302 140200040903003	I
Razor Creek and tributaries.	140200035101	II
Beaver Creeks including Deer Beaver and South Beaver Creeks.	140200025001	I
Beaver Creek including North and West Beaver Creeks.	140200020310	I
Upper West Muddy Creek and tributaries including Dyke Creek.	14020004550201 14020004550202	I

***Figure 5E2-1**. Catchments supporting Conservation populations of CRCT, and those where expansion to establish meta-populations may be feasible.*



Boreal Toad

Introduction

The boreal toad (*bufo boreas boreas*) was once widely distributed in 11 geographic areas/mountain ranges across the Rocky Mountain Region from the mountains of southeastern Wyoming to the San Juan Mountains in northern New Mexico. Over the past 25 years boreal toad populations have decreased dramatically, so much so that the Fish and Wildlife Service (FWS) in 1995 designated the Southern Rocky Mountain Population (SRMP) a candidate for Federal listing. Subsequent reviews by FWS found the toad warranted for listing, but it is currently precluded due to a backlog of species listing actions of higher priority. Through a legal settlement, the FWS agreed to decide to list boreal toad by September 2005. Boreal toad is also considered to be sensitive by Region 2 of the Forest Service and endangered by the State of Colorado. The GMUG contains historic and currently occupied habitat for boreal toad.

Status

In 1994 a multi-agency Boreal Toad Recovery Team (BTRT) was established to provide coordinated recommendations on the conservation and management of boreal toad. The first Conservation Plan completed by this group was done in 1994. Subsequent additions to the Plan have been completed since 1994 with the most recent completed in 2001 with an accompanying agreement signed by participating groups, including the Rocky Mountain Region of the Forest Service (Loeffler 2001).

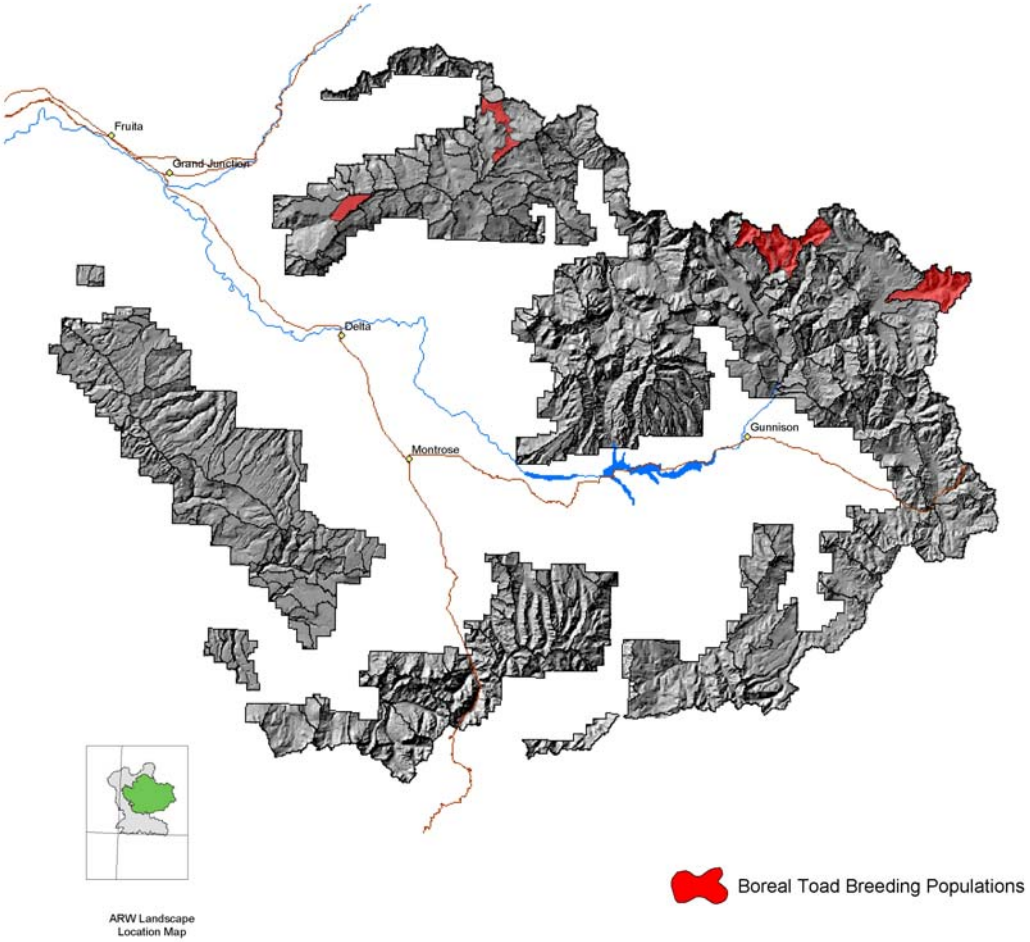
The BTRT Conservation Plan (Conservation Plan) established recovery objectives before they can be de-listed in the State of Colorado. Criteria established for de-listing are:

> ***There must be at least two (2) viable breeding populations of boreal toad in each of at least nine (9) of the eleven areas/mountain ranges and State-wide, there must be at least 25 viable breeding populations. The BTRT Plan also provides criteria to determine whether or not a population is viable.***

Geographic areas/mountain ranges on the GMUG with historic boreal toad occurrences are the Grand Mesa, West Elk Mountains and Sawatch Range. Specific locations in these geographic areas historically (information > 10 years old) occupied by toad include the headwaters of Tongue and Currant Creek watershed (1402000513), Kannah Creek watershed (1402000515); Upper Gunnison River (14020002), East Taylor River (14020001) and Tomichi Creek (14020003) watersheds on the Sawatch Range.

Current (infromation <10 years old) distribution of boreal toad has been reduced to less than 1% of their historic breeding sites in the SRMP. While extensive surveys are lacking for the GMUG , similar reductions from historic levels have most likely occurred. Current distribution is restricted to a few breeding sites in scattered 6^{th} and 7^{th} level HUCs on the GMUG (Figure 5E2-2). Most of these known populations are small and restricted.

Figure 5E2-2. Current distribution of documented or suspected boreal toad breeding populations on the GMUG by 6th or 7th level HUC. Actual breeding areas are generally restricted to a few locations within the sub-watersheds.



Nine sub-watersheds on the GMUG are known to support boreal toad populations (Table 5E2-3). Breeding ponds are known to occur in 6 of the nine sub-watersheds. Most of the breeding ponds are small (<1 acre) and generally occur in a few locations in the sub-watersheds. Two watersheds (Buzzard Creek sub-sheds) have documented occurrence of boreal toad but specific breeding ponds have not been located to date. Boreal toad translocation efforts have been conducted by CDOW in Kannah Creek sub-watershed since 2003. Most of the known populations occur in Integrity class 2 sub-watersheds, although Texas Creek and Cooper Creek are in integrity class 3 and 4 respectively.

Table 5E2-3. Occupied boreal toad habitat by 6th or 7th field HUC on the GMUG .

Watershed Name	6th or 7th Field HUC	Documented breeding sites	Watershed Integrity Class
Texas Creek	140200019508	Yes	3
Upper Taylor River	14020001950905	Yes	2
East Brush Creek	14020001990602	Yes	2
Middle Brush Creek	14020001990603	Yes	2
West Brush Creek	14020001990604	Yes	2
Copper Creek	140200019909	Yes	4
Upper Buzzard Creek Composite	14010005190601	No – Adults observed along Buzzard Creek.	2
Upper Buzzard Creek	14010005190605	No - Adults observed along Buzzard Creek.	2
Upper Kannah Creek	14020005150107	No – CDOW translocation site.	2

The distribution and abundance of boreal toad have declined on the GMUG from historic levels. A combination of factors is likely attributing to this decline, but no single factor has been identified as the primary threat to boreal toad habitat. Current information about habitat condition and trends are generally unavailable and population inventories have only occurred in a few locations on the GMUG.

Boreal toads are susceptible to a variety of bacterial and fungal pathogens. In particular, chytrid fungus (*Batrachochytrium dentrobatidis*) is believed to be the primary disease causing pathogen. This pathogen is believed to be the most pervasive factor affecting the number of toads and habitat quality range-wide and on the GMUG. Although this pathogen is a major factor leading to decline of boreal toad, land management activities that negatively affect breeding and other habitats of boreal toad also are believed to be attributing to their decline.

Botanical Threatened and Endangered Species

There are six sensitive plant species known to occur on the GMUG:

- Carex limosa (mud sedge)
- Drosera rotundifolia (round leaf sundew)
- Eriophorum altaicum var. neogaeum (Altai or whitebristle cottongrass)
- Eriophorum gracile (slender cottongrass)
- Salix candida (Hoary willow)
- Utricularia minor (lesser bladderwort)

and one species that occurs nearby but has not been found on the Forest:

- Eriophorum chamissonis (russet cottongrass)

These species are all widely distributed (globally), but are regarded as sensitive because of the patchy or discontinuous nature of the specific habitat they require, at least on the GMUG. A fuller characterization of each will be available in the appendix addressing species of interest in the Comprehensive Evaluation Report (CER) of 2005.

Known occurrences of the species on the Forest are limited, ranging from 1 up to 5 or 6 populations, and found only in wetland or fen conditions. Additional, but undocumented populations are likely to exist across the Forest where similar suitable habitat exists.

Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Water Yield

One of the fundamental values of the National Forests is provision of favorable conditions of flow. Runoff from the watershed into the drainage network is one of the key functions of high elevation or upper sub-watershed basins. Properly functioning watersheds infiltrate, store and yield precipitation into the drainage network providing water for on-forest as well as downstream values. Fundamentally, water yield is a physical characteristic of watersheds. The yield provides for an array of ecological and social values, which may occur on or off the GMUG. The portion of yield that is utilized for human needs and economic gain is a social value which is addressed in the section on consumptive uses.

Annual water yield estimates are based on the results of Kircher (et als) investigation of natural flow characteristics in western Colorado. The drainage basin area, annual precipitation, basin elevation (climatic zones), and watershed basin slope are the characteristics that determine annual yield using these estimation methods.

Drainage basin area is the most influential variable in the estimation of yield, the larger the 6th level HUC sub-watershed the greater the total yield. To compare the relative yields between sub-watersheds on the GMUG, the estimated total annual yield is expressed as inches of runoff per unit area, which is analogous to the measurement of precipitation in inches. Forest-wide results are displayed in Figure 5E3-1.

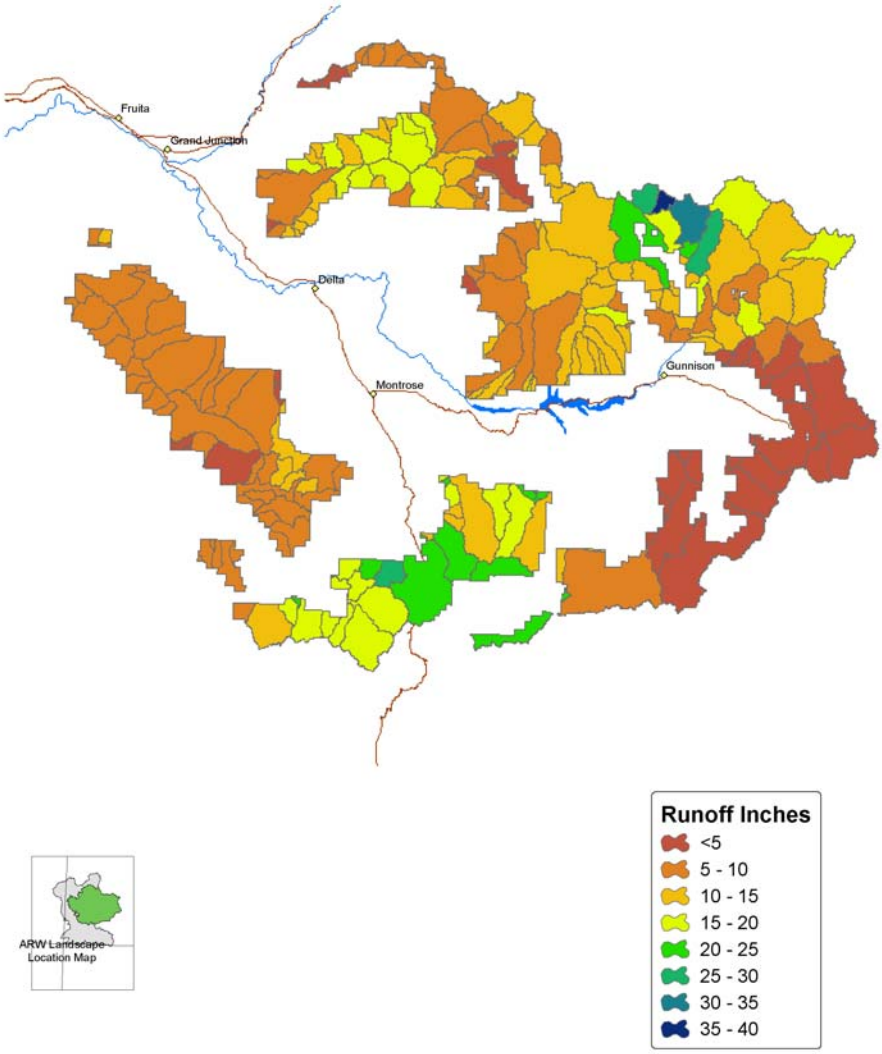
Yield ranges from 1.5 inches to 36.9 inches for the 225 sub-watersheds on the GMUG. The average estimated yield value for all of the GMUG sub-watershed is 10.9 inches. The majority of the sub-watersheds with yields greater than 20 inches (Table 5E3-1) drain high elevation areas that are subject to more snowfall with many of these high yield sub-watersheds being in the East River basin of the upper Gunnison River.

Table 5E3-1. GMUG Sub-watersheds with High Yield

Geographic Area	HUC	Name	Yield (inches)	Sensitivity Rating
Gunnison	140200019909	Cooper Creek	36.9	4
Gunnison	140200024903	Pine Creek	34.9	1
Gunnison	140200019906	Brush Creek	30.1	4
Gunnison	140200019910	Upper East River	29.3	4
San Juan	140200067903	East Fork Dallas Creek	29.0	4
Gunnison	140200019904	Cement Creek	25.3	4
San Juan	140200067901	Upper Uncompahgre River	24.9	4
San Juan	140200064801	Upper Cow Creek	23.5	4
San Juan	140200067904	West Fork Dallas Creek	22.9	3
Gunnison	140200020304	Dry Gulch	22.2	1
Gunnison	140200028304	Willow Creek	21.8	1

Geographic Area	HUC	Name	Yield (inches)	Sensitivity Rating
Gunnison	140200028303	Upper Lake Fork	21.7	4
San Juan	140200064805	Deer Creek	21.4	2
Gunnison	140200028302	Hensen Creek	21.3	4
Gunnison	140200019908	Slate River	21.3	4
San Juan	140300034703	Specie Creek	21.1	1
Gunnison	140200019905	Farris Creek	20.7	4
Gunnison	140200024902	Little Blue	20.1	1
San Juan	140200024902	Deep Creek	20.0	3

Figure 5E3-1. Average Annual Runoff in Inches.



Sub-watersheds with the lowest yields are predominately located in the southern portion of the upper Gunnison River basin, which is commonly referred to as the "dry side" of the San Juan range of mountains. This area has lower elevation upper watershed areas and receives less snow and rainfall than other areas of the GMUG. Table 5E3-2 lists those sub-watersheds with estimated yield values of 4.0 inches or less.

Table 5E3-2. GMUG Sub-watersheds with Low Yield

Geographic Area	HUC	Name	Yield (inches)
Gunnison	140200025001	Upper South Beaver	4.0
Uncompahgre	140300034505	Coal Creek	3.9
Gunnison	140200038905	Cabin Creek	3.9
Gunnison	140200039102	Marshall Creek	3.7
Uncompahgre	140200045807	Cottonwood Creek (eastside)	3.6
Gunnison	140200038904	Sewell Gulch	3.6
Gunnison	140200039101	Long Branch Creek	3.5
Gunnison	140200025002	Lower South Beaver	3.4
Uncompahgre	140200065002	Coalbank/Big Sandy	3.3
Gunnison	140200038701	Upper Cochetopa Creek	3.1
Gunnison	140200039301	Lower Quartz Creek	2.9
Gunnison	140200035101	Upper Razor Creek	2.9
Gunnison	140200038702	Los Pinos Creek	2.8
Gunnison	140200038903	Wood Gulch	2.8
Gunnison	140200038906	Stubbs Gulch	2.6
Gunnison	140200038704	Lower Cochetopa Creek C.	2.6
Grand Mesa*	140100051702	Anderson Gulch	2.4
Grand Mesa*	140100051701	Lower Plateau Creek	2.3
Gunnison	140200038902	Hot Spring Creek	2.3
Gunnison	140200035102	Prosser Creek	2.1
Uncompahgre	140200065003	Roatcap Gulch	2.0
Gunnison	140200038703	West Pass Creek	1.6
Gunnison	140200038901	Middle Tomichi Creek C.	1.5
Gunnison	140200035103	Lower Razor Creek C.	1.5

* This area of the Grand Mesa Geographic Area is known as the Battlements, a south facing range of mountains north of the Grand Mesa

CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Values

Riparian Cottonwood Stands

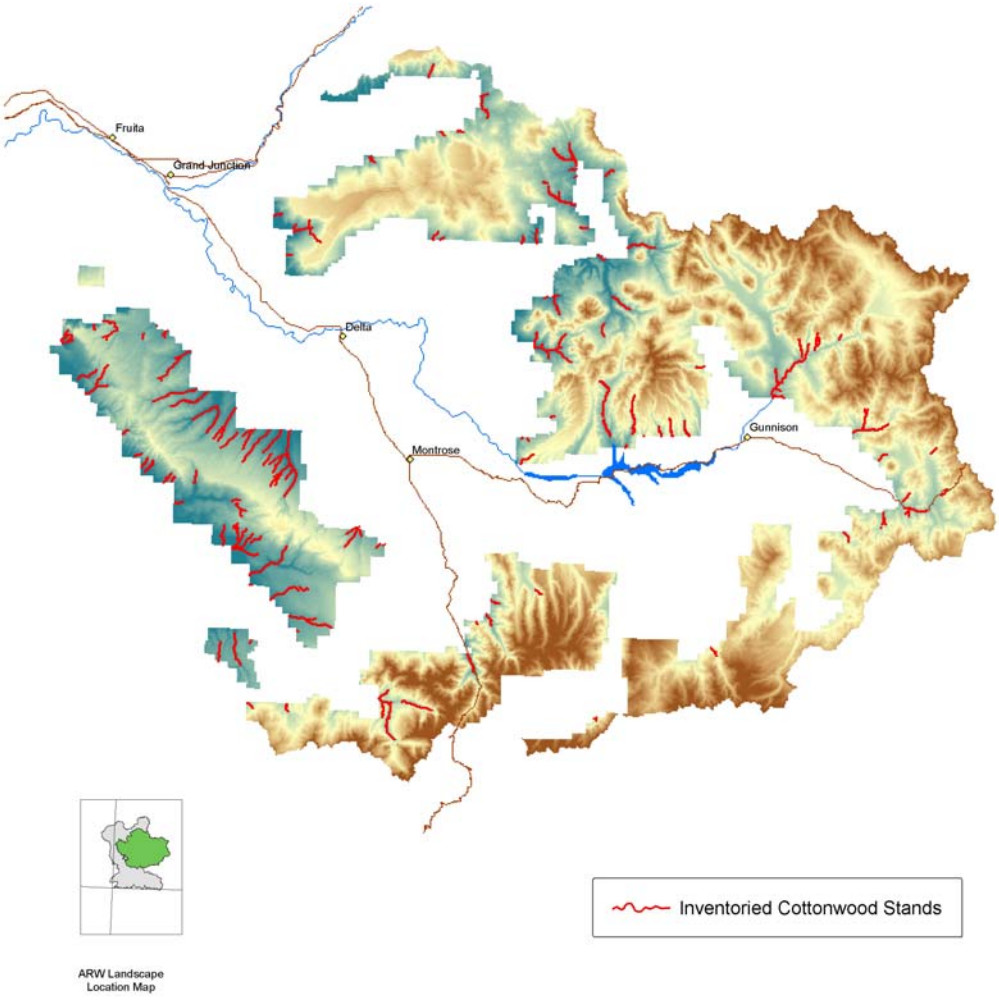
Stands of narrowleaf cottonwood (Populas augustifolia) along streams are regarded as an indicator of more natural stream flow conditions where there is periodic flooding, scour, sediment deposition, and groundwater storage along portions of a stream where these stands occur. Riparian stands of cottonwoods provide important habitat for many wildlife species, shade for aquatic species, and help to maintain bank and channel stability. Ecologists believe the narrowleaf cottonwood stands are on the decline throughout the west, and because of their ecological value in the riparian vegetative communities should be managed to maintain their viability. The decline has coincided with widespread water development along rivers and streams, and groundwater pumping (Lytle & Merritt, 2005).

Available Forest Service inventories (IRI-CVU and IRI-CWU) were utilized to identify stream segments where narrowleaf cottonwood is the dominant or co-dominant species present. Forest-wide, 83 sun-watersheds support riparian cottonwood communities totaling nearly 450 stream miles, which are illustrated in Figure 5E4-1. The inventoried stands are most common at the lower elevations of the GMUG, and along streams with low stream gradients. The most frequent occurrence is along the main tributaries on both the east and west sides of the Uncompahgre Plateau. It is not unexpected that the majority of streams on the GMUG lack riparian cottonwood stands given the typically high elevations of the sub-watersheds, and prevalence of steep channel gradients. Sub-watersheds with the more than 10 miles of riparian cottonwood are depicted in Table 5E4-1.

Table 5E4-1. GMUG Sub-Watersheds with the most Miles of Riparian Cottonwood Stands

Geographic Area	HUC	Name	Miles of Cottonwood Stand
Uncompahgre	140200057701	Roubideau Creek	37.5
Uncompahgre	140300034501	Cottonwood Creek (Westside)	23.2
Uncompahgre	140200057501	Escalante Creek	19.9
Gunnison	140200019501	Lower Taylor River Composite	16.7
North Fork	140200020501	Smith Fork	16.1
Uncompahgre	140200057702	Potter Creek	13.1
Gunnison	140200038901	Middle Tomichi Creek Composite	12.5
Grand Mesa	140200051501	Kannah Creek	11.7
Gunnison	140200020301	Soap Creek	10.2
Uncompahgre	140200020301	Little Dominquez	10.0

Figure 5E4-1. Riparian Cottonwood Stands.



CHAPTER 5. SUB-WATERSHED CONDITION ASSESSMENT – FOREST SCALE

Values

Adjustable Channels

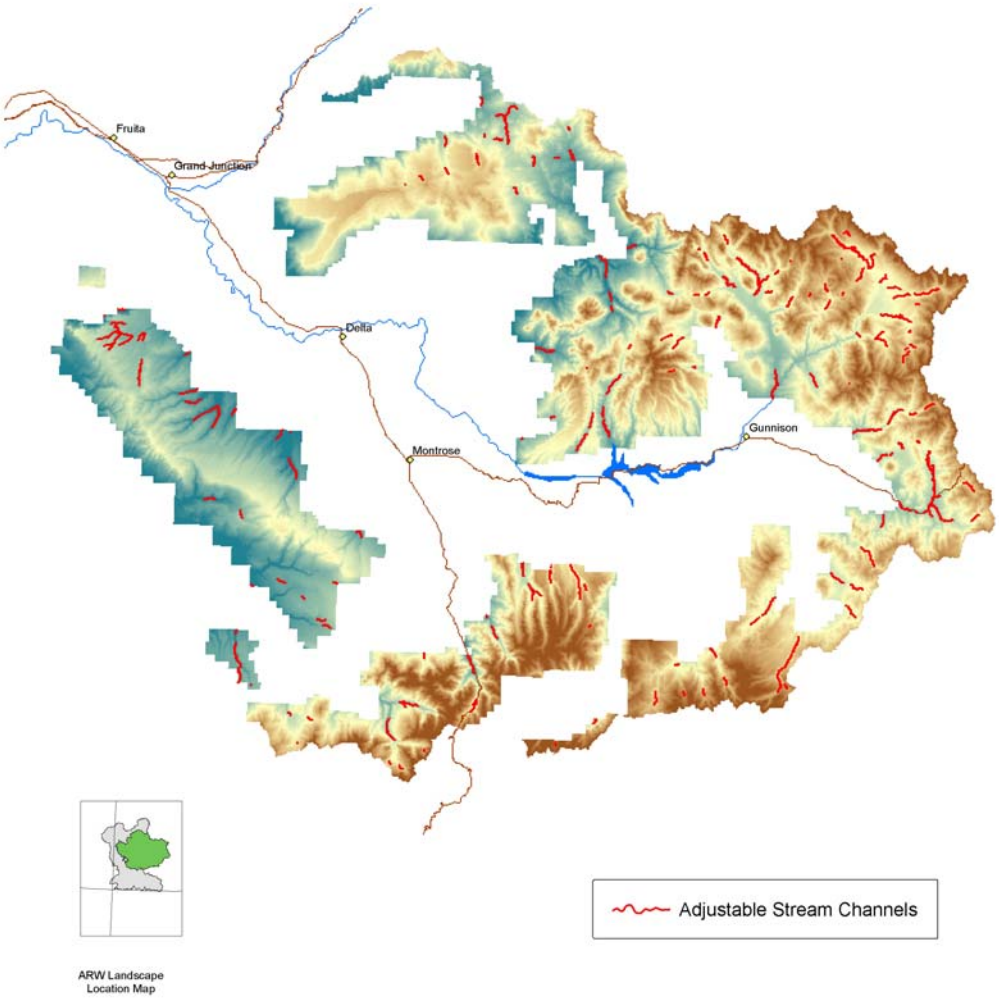
Stream channel pattern and geometry develop to allow efficient movement of water and sediment. Generally, streams with an active floodplain (permit lateral movement and adjustment of the main channel), have a range of meander wavelengths and gradients that provide desirable pool to riffle ratios for aquatic species. Adjustable stream segments potentially provide valuable riparian and aquatic habitat for desired fish and aquatic species on the GMUG. Therefore, the miles of stream with adjustable channel characteristics were considered an aquatic ecosystem value.

For this assessment, adjustable stream segments were defined by the following criteria: stream order >=3, with gradient <= 1.5%, alluvial channel material (active floodplain), and a predominance of Rosgen stream types of C, D, or E (Rosgen, 1996). The IRI_CWU inventory was used to identify all portions of the stream network meeting those criterion which are illustrated in Figure 5E5-1. They occur in 75 separate sub-watersheds across the GMUG, and total approximately 384 miles. The majority (66 percent) of the sub-watersheds on the Forest do not include any streams with the combination of characteristics associated with the adjustable channels. An expected result, given that the majority of the sub-watersheds on the GMUG are generally high elevation, headwaters with steep gradients and stream types A and B (Ibid). Sub-watersheds with more than 10 miles of adjustable channels delineated are listed in Table 5E5-1.

Table 5E5-1. GMUG Sub-watersheds with Highest Adjustable Channel Values

Geographic Area	HUC	Name	Miles of Adjustable Channel
Gunnison	140200039103	Upper Tomichi Creek	22.4
Uncompahgre	140300046901	Upper West Creek	20.5
Gunnison	140200038701	Upper Cochetopa Creek	15.5
Gunnison	140200019506	Middle Taylor River Composite	14.9
Grand Mesa	140100051906	Upper Buzzard Creek	14.7
Uncompahgre	140200057501	Escalante Creek	13.8
Gunnison	140200019507	Willow Creek	13.5
Gunnison	140200019907	Middle East River Composite	13.4
Gunnison	140200019509	Upper Taylor River	11.2
Gunnison	140200039301	Lower Quartz Creek Composite	10.1

Figure 5E5-1. Adjustable Stream Channel Segments.



Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Riparian Areas and Wetlands

Riparian and wetland vegetative communities are ecosystem components that are associated with surface water drainage networks, open water bodies (lakes and reservoirs), and or groundwater. The abundance of these vegetative communities indicates a level of natural watershed function and because of their symbiotic relationship to many other terrestrial species is important in the overall function of the ecosystem. Riparian areas and wetlands fill varied needs for many terrestrial species, particularly avian species and rare botanical species. Fens are a unique subset of wetlands often providing habitat for rare species as evidenced by the Mountain-Prairie Region of the U.S. Fish and Wildlife Service designation as a non-renewable resource (Resource Category 1). A total of 32 riparian and or wetland dependent plant species have been identified as potential species of interest during evaluation of ecosystem and species diversity and will be documented in a Plant Technical Report appendix to the Comprehensive Evaluation Report (CER) of 2005.

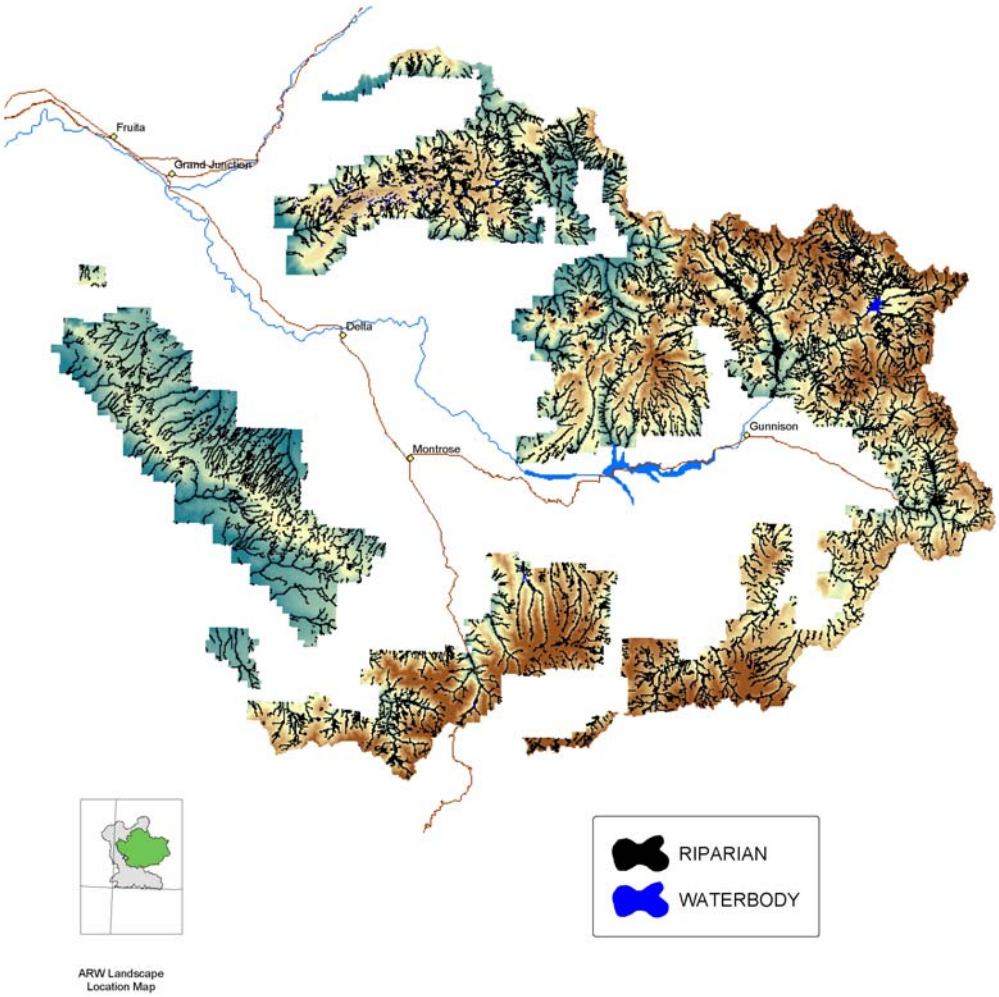
The presence of riparian or wetland related communities is fairly widespread across the Forest, with over 90 percent of the sub-watersheds having some measurable acreage. There are roughly 100,000 acres of general riparian habitat currently inventoried across the GMUG and additional acreage along shorelines associated with the some 11,500 surface acres occupied by lakes and reservoirs (see Figure 5E6-1).

Healthy functional riparian areas and wetlands are valuable for a number of reasons. Large contiguous blocks are considered especially valuable for wildlife, often providing continuous corridors of cover along streams, protected access to water, nesting habitat, and considerable edge effect. On the GMUG, there are 31 sub-watersheds with 1,000 acres or more of riparian and or wetland vegetative communities. The Middle Taylor River composite and the Upper Cebolla Creek sub-watersheds contain the most, with over 4,000 total acres. All sub-watersheds with 2,000 total acres or more are listed in Table 5E6-1.

Table 5E6-1. Aerial extent of riparian areas and wetlands.

Geographic Area	HUC	Name	Acres
Gunnison	140200019506	Middle Taylor River Composite	4,577
Gunnison	140200028502	Upper Cebolla Creek	4,042
Gunnison	140200019509	Upper Taylor River	3,571
Gunnison	140200039103	Upper Tomichi Creek	3,058
North Fork	140200040701	Anthracite Creek	2,900
Gunnison	140200019507	Willow Creek	2,867
Gunnison	140200038701	Upper Cochetopa Creek	2,838
Gunnison	140200019908	Slate River	2,512
Uncompahgre	140200019505	Spring Creek	2,294
North Fork	140200040702	Coal Creek	2,139
Grand Mesa	140100051906	Upper Buzzard Creek	2,093
Grand Mesa	140100051707	Leon Creek	2,069

Figure 5E6-1. Current Riparian/Wetland Inventory.



Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Water-Dependant Special Plant Communities

The Colorado Natural Heritage Program (CNHP) has identified and mapped various natural plant communities throughout Colorado that they have deemed to be of special interest. These plant communities are considered to be of special interest because they are unique in Colorado, or they contain rare plants for this region. The Forest Service considers these special plant communities to have broad ecological value in terms of biodiversity and natural ecological process. Often, these communities may be on the fringe of their natural range in Colorado or they may be declining in abundance due to land-use activities. The CNHP information is not an exhaustive inventory of all occurrences, but does provide a reasonable basis for characterizing those that are known.

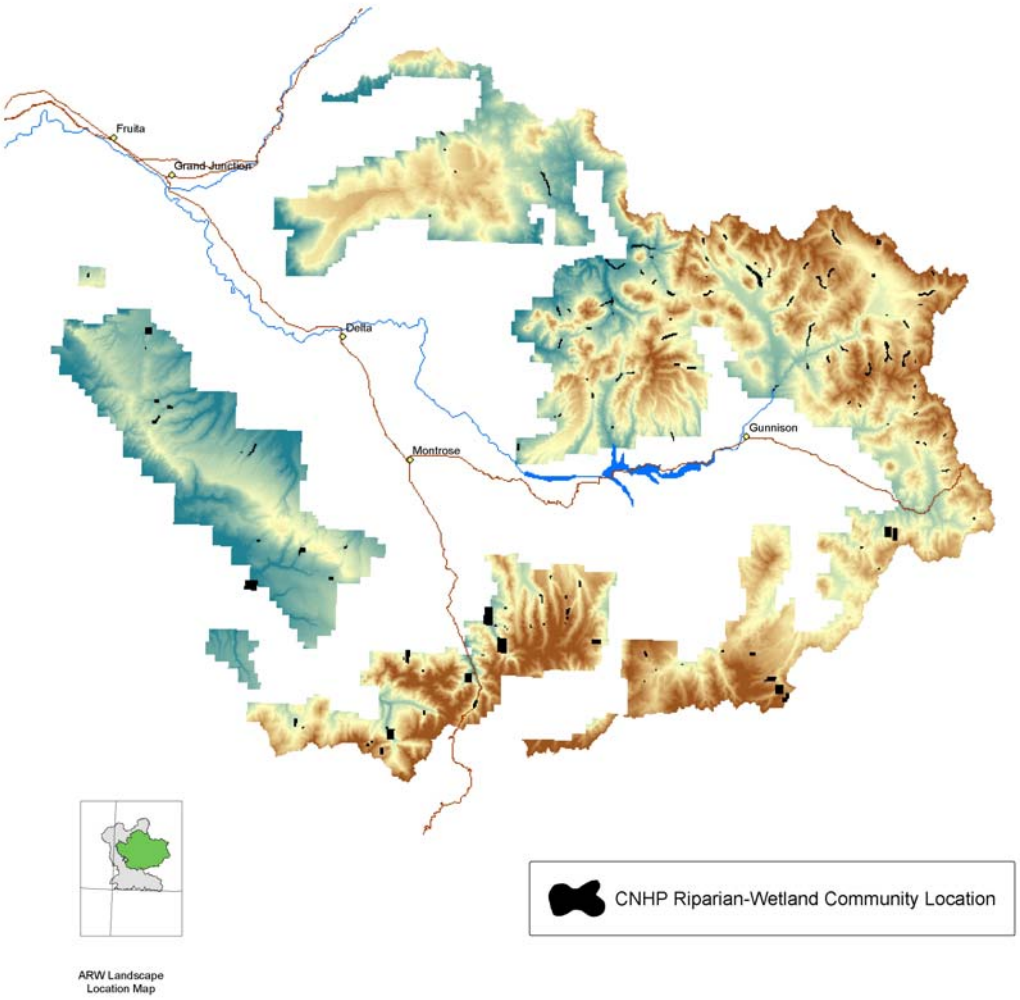
The 43 broad Natural Heritage Program plant communities occurring across the GMUG include 31 that are water-dependent, which include both riparian and wetland communities (see Figure 5E7-1). Those 31 communities include 52 unique species mix combinations. Because the CNHP inventory includes a range of mapping accuracy, it is most appropriately used to describe the frequency of occurrences.

Forest-wide, a total of 182 occurrences are documented across 65 sub-watersheds, and 45 of them have two or more occurrences. Frequency of total occurrences, unique communities, and unique species mix combinations are summarized in Table 5E7-1 for sub-watersheds with 5 or more total occurrences. Anthracite Creek in the North Fork Geographic Area had the highest counts in all categories.

Table 5E7-1. GMUG Sub-watersheds with the Most Special Plant Communities

Geographic Area	HUC6	Name	Acres of Riparian	Total	Communities	Unique Spp Mix
North Fork	140200040701	Anthracite Creek	2,900	12	6	9
Gunnison	140200038701	Upper Cochetopa Creek	2,839	7	4	5
San Juan	140200064801	Upper Cow Creek	200	7	3	5
San Juan	140300036304	South Fork San Miguel River	1,240	7	5	5
Gunnison	140200019908	Slate River	2,512	6	5	5
Gunnison	140200028502	Upper Cebolla Creek	4,042	6	5	6
Gunnison	140200039103	Upper Tomichi Creek	3,058	6	4	5
Gunnison	140200019507	Willow Creek	2,867	5	3	4
Gunnison	140200020105	Pass Creek	240	5	4	5
North Fork	140200040702	Coal Creek	2,138	5	2	4
San Juan	140200067901	Upper Uncompahgre River	602	5	4	5

Figure 5E7-1. Riparian Plant Communities from 2004 CNHP Inventory.



Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Public Water Supplies

An initial purpose of the National Forest system was and remains to "secure favorable conditions of water flows". A wide variety of values or uses depend upon the runoff generated from the GMUG. Those values or uses are realized both on and off the Forest. The most prominent consumptive uses are for agricultural and municipal purposes.

A number of communities rely on surface and ground water originating on the GMUG NFs for their public drinking water supplies. The Colorado Department of Public Health and Environment (CDPHE) is the lead agency in assuring that safe drinking water is provided by all public systems in the state, and for enforcing standards established by the Safe Drinking Water Act. There are a total of 18 surface water providers (32 separate systems or source water areas) that include at least some GMUG administered lands (Table 5E8-1 and Figure 5E8-1). Ground-water dependent systems within the GMUG NF include 42 active private providers (Table 5E8-2) and 39 Forest Service facilities (Table 5E8-3). An additional 26 private ground-water based providers occur within 2.5 miles of the GMUG . The 2.5-mile distance corresponds to the fixed radius basis used by the CDPHE to define wellhead protection areas. A combined population of about 175,000 people is served by the various sources according to CDPHE data.

Under the Source Water Area Assessment (SWAA) program there are often multiple systems (tracked by identification numbers or SWAA ID#) for one water provider. Each system corresponds to a unique source area. The source areas may include many sub-watersheds on the GMUG like the Gunnison County Dos Rios system, or include only a portion of a sub-watershed such as the Town of Cedaredge.

The source areas range from just 500 acres to over 2 million acres in size, with the proportion lying within GMUG NFs varying from approximately 4% to as much as 100%. Generally, the greater the proportion of NF lands in a source water area the greater the potential to be directly affected by Forest Service land use and management activities.

Existing Forest Service direction is to manage lands for multiple-uses, which requires balancing present and future resource use with public water supply needs. Forest-wide water quality is generally excellent based on the support of classified uses, and attainment of numeric and narrative water quality standards established by the Colorado Department of Health and Environment (CDPHE).

GMUG lands are considered the principal source for surface based systems where 70% or more of the total supply area lies within the forest boundary. Forest-wide that includes 21 separate systems (managed by 16 providers), totaling approximately 1,038,000 acres. The current Plan has a Management Prescription 10E emphasizing municipal watersheds only for the Fruita division of the Grand Mesa NF, an area that totals approximately 7,850 acres. No other source water areas are designated in the 1991 Forest Plan.

The CDPHE 303d list of impaired stream segments includes Coal Creek (which serves as the Town of Crested Butte's principal drinking water source. The contaminants of concern (Cadmium, Lead, and Zinc) are associated with historic operations at the Standard Mine site. In April 2005, the site was proposed for inclusion on the National Priorities List which if adopted would make it eligible for "Superfund" remediation. Despite the 303d listing, Coal Creek currently meets Safe Drinking Water Act standards.

Table 5E8-1. Surface Water dependent providers

Geographic Area	System or SWAA ID #	Provider	Source Water Area (acres)	Acres in GMUG	Percent within GMUG
Grand Mesa	140100-026	Ute Water Conservancy District	544,601	24,302	4.5
Grand Mesa	140100-028	Ute Water Conservancy District	15,349	6,951	45
Grand Mesa	140100-029	Powderhorn MD#1	727	727	100
Grand Mesa	140100-030	Ute Water Conservancy District	11,418	3,758	33
Grand Mesa	140100-032	Ute Water Conservancy District	5,797	1,284	22
Grand Mesa	140100-034	Ute Water Conservancy District	209,403	116,502	56
Grand Mesa	140100-035	Town of Collbran	55,915	43,133	77
Grand Mesa	140200-003	Town of Cedaredge	545	545	100
Grand Mesa	140200-004	Town of Hotchkiss	28,097	22,383	80
Gunnison	140200-007	Town of Crested Butte	8,783	8,783	100
Gunnison	140200-008	Town of Crested Butte	1,161	711	61
Gunnison	140200-009	Mt. Crested Butte WS&D	20,796	20,792	100
Gunnison	140200-010	Gunnison County -Dos Rios	616,948	515,125	83
Grand Mesa	140200-011	City of Grand Junction	1,326	537	40
Grand Mesa	140200-012		1,976	1,616	82
Grand Mesa	140200-013	City of Grand Junction	37,215	36,982	99
Gunnison/ Uncompahgre	140200-014	Project 7 Water Authority	1,860,546	915,031	49
Uncompahgre	140200-016	Town of Ridgway	2,207	2,001	91
Gunnison	140200-017	Fruitland Domestic WC	27,335	23,591	86
Gunnison	140200-018	Bowie Mine #2	37,041	27,327	74
Gunnison	140200-019	Mtn.Coal Co-West Elk Mine	2,442	2,442	100
Gunnison	140200-020	Mtn.Coal Co-West Elk Mine	337,590	293,441	87
Gunnison/ Uncompahgre/ Grand Mesa	140200-022	City of Grand Junction	2,130,075	571,554	27
Grand Mesa	140200-024	City of Grand Junction	6,455	5,355	83
Grand Mesa	140200-028	Town of Cedaredge	1,801	1,801	100
Grand Mesa	140200-029	Town of Cedaredge	3,957	3,957	100
Grand Mesa	140200-030	Town of Cedaredge	963	963	100
Uncompahgre	140300-005	Wilson Mesa MD	1,979	1,971	99
Uncompahgre	140300-006	Town of Telluride	3,432	3,432	100
Uncompahgre	140300-009	Town of Nucla	63,930	38,277	60
Uncompahgre	140300-010	Town of Nucla	385,774	233,646	61
Uncompahgre	140300-011	Nucla & Norwood Water Commission	21,624	21,161	98

Table 5E8-2. Private ground-water dependent providers

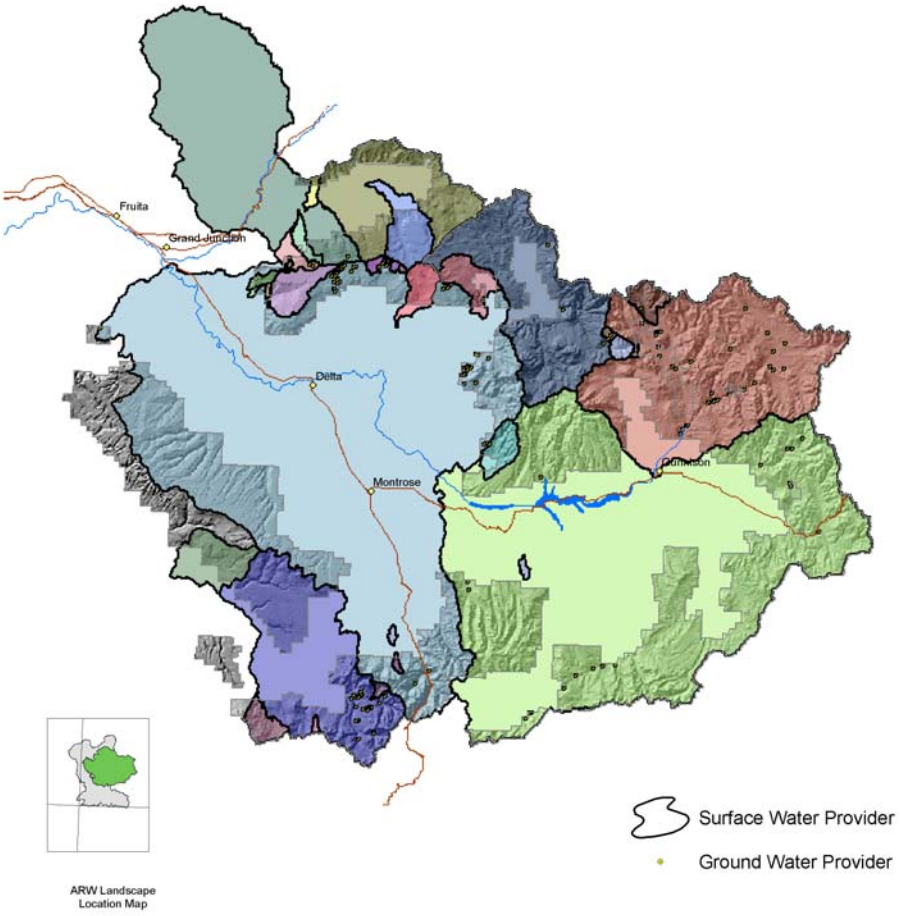
PWSID	SYS_NAME	Within GMUG
115152	Bone Mesa WD	Y
115168	Cathedral WC	Y
115171	Cedaredge, Town of	Y
115185	Coalby Domestic WC	Y
115188	Crawford, Town of	Y
115189	Crawford Mesa WA	Y
115467	Lazear Water Company	Y
115588	Orchard City, Town of	Y
115601	Paonia, Town of	Y
115610	Pitkin Mesa Pipeline Comp	Y
126189	Crested Butte South Metro	N
126190	Mt. Crested Butte W&SD	Y
126190	Mt. Crested Butte WS&D	Y
126505	Meridian Lake Park	Y
126677	Riverland Lot Owners	N
126718	Somerset WD	N
126834	Way Family Ranch-Camp Gun	N
127467	Lake City, Town of - W&SD	N
146588	Ouray, City of	Y
146592	Elk Meadows Estates	N
157011	Aldasoro Ranch HOA	Y
157250	Ilium Valley WS	Y
157300	Last Dollar PUD	Y
157400	Mountain Village MD	Y
157500	Norwood Water Commission	N
157600	Ophir, Town of	Y
157700	Sawpit, Town of	N
157800	Telluride, Town of	Y
215225	Deutsch Pipeline/NeedleRk	N
215288	Frost RV Park	Y
215321	Grand Mesa Christian Assn	Y
215538	Mad Dog WC	Y
226105	Adventure Experiences,Inc	Y
226113	Almont Resort	Y
226143	Big Horn Guest Ranch	Y
226188	CBMR-Paradise Warming Hou	Y
226189	Crystal Meadows Ranch	N
226333	Harmel's Ranch Resort	Y
226352	Holt's Guest Ranch	Y
226480	Lost Canyon Resort	Y
226645	Rock at Ute Trail Ranch	N
226650	Rocky Mt. Biological Lab	Y
226712	Skyland MD	Y
226736	Taylor Park Trading Post	Y
226742	Three Rivers Resort	Y
226761	CBMR-Twister Warming Hous	Y
226833	Waunita Hot Springs	Y

PWSID	SYS_NAME	Within GMUG
226844	Youth w/a Mission/High Pk	N
226845	El Rancho	N
227166	Castle Lake Campgrounds	Y
227167	Camp Red Cloud	Y
227188	Crystal Lodge, The	N
227318	Lakeview Resort, Inc.	N
227700	San Juan Ranch HOA	N
227810	Vickers Dude Ranch	N
239505	Mesa Lakes Resort	Y
239618	Powderhorn MD #1	Y
239749	Vega SRA - ASPEN GROVE	N
239750	Vega SRA -Oak Point	N
239761	Twin Peaks Bible Camp	N
239805	Vega SP-Early Settlers	N
239806	Vega Lodge	N
243176	Cimarron Inn	N
246452	KOA - Ouray -Switzerlnd o	N
255400	Elks Run (frmly Dotty's)	Y
257050	Telluride Regional Airprt	Y
257300	Camp Ilium	Y
257600	Miramonte State Wildlife	N

Table 5E8-3. Forest Service Ground-water dependent sites

PWSID	System
315166	Carp Lake CG/Ward Lake CG
315190	Crag Crest CG
315240	Eggleston Lake CG
315310	Visitor Center
315390	Island Lake CG/Little Bea
326009	Curecanti -Ponderosa
326114	Almont Campground
326140	Beaver Lake Campground
326171	Cement Creek Campground
326210	Dinner Station Campground
326218	Dorchester Campground
326463	Lake Irwin CG
326467	Lake View Campground
326484	Lodgepole Campground
326487	Lottis Creek Campground
326502	Erickson Springs Campgrou
326503	McClure Campground
326518	Mosca Campground
326552	North Bank Campground
326584	One Mile Campground
326610	Pitkin Campground
326660	Quartz Creek Campground
326676	Rivers End Campground
326685	Rosy Lane Campground
326710	Silver Jack Campground
326719	Spring Creek Campground
327172	Cebolla Campground
327173	Mineral Creek Trailhead
327205	Deer Lakes Campground
327342	Hidden Valley Picnic Grou
327715	Slumgullion Campground
327842	Williams Creek Campground
339210	Divide Forks CG
339290	Fruita Picnic Area
339718	Cottonwood Campground
339719	Spruce Grove / Jumbo Camp
346116	Amphitheater Campground
357500	Matterhorn CG
357725	Sunshine CG

Figure 5E8-1. Public Drinking Providers Surface and Groundwater Sources.



Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

General Recreation

Frequently, there is a link between general recreational use (hiking, camping, sightseeing, and picnicking) on the GMUG and streams, lakes, reservoirs, and riparian areas. Forest Service knowledge and experience regarding locations and patterns of use were utilized to evaluate recreational values associated with water features. Streams and stream corridors considered recreational attractions were identified, and include a range of use types or intensities (hunting season only dispersed use, summer long developed use sites, unique water features, clearly visible from a developed vista site, designated trail or byway). Lakes and reservoirs considered recreational attractions for general, boating, or fishing related uses were also identified. All identified streams, lakes, and reservoirs are shown in Figure 5E9-1.

Forest-wide, 61 sub-watersheds include streams with recognized recreational values totaling some 410 miles. Total miles by sub-watershed ranges from 0.0 (in the 161 sub-watersheds lacking identified streams) to 21 miles in the Slate River sub-watershed. The sub-watersheds with 10 miles or more of stream providing a general recreation attraction are listed in Table 5E9-1 below.

Table 5E9-1. Sub-watersheds the Most Stream Miles of General Recreation

Geographic Area	HUC	Watershed	Stream Miles
Gunnison	140200019908	Slate River	21.2
San Juan	140200067901	Upper Uncompahgre River	19.0
Gunnison	140200038701	Upper Cochetopa Creek	18.6
Gunnison	140200019501	Lower Taylor River Comp.	17.9
Grand Mesa	140100051707	Leon Creek	17.3
North Fork	140200045801	East Leroux Creek	17.0
Gunnison	140200019907	Mid East River Comp.	15.2
Gunnison	140200019904	Cement Creek	15.0
North Fork	140200040701	Anthracite Creek	14.6
Grand Mesa	140100051906	Upper Buzzard Creek	14.2
Gunnison	140200039304	Upper Quartz Creek	13.2
North Fork	140200040702	Coal Creek	13.1
Gunnison	140200019505	Spring Creek	12.2
Grand Mesa	140200051309	Surface Creek	11.2
Gunnison	140200019509	Upper Taylor River	10.8
Gunnison	140200039301	Lower Quartz Creek Comp.	10.4
Gunnison	140200028502	Upper Cebolla Ck	10.0

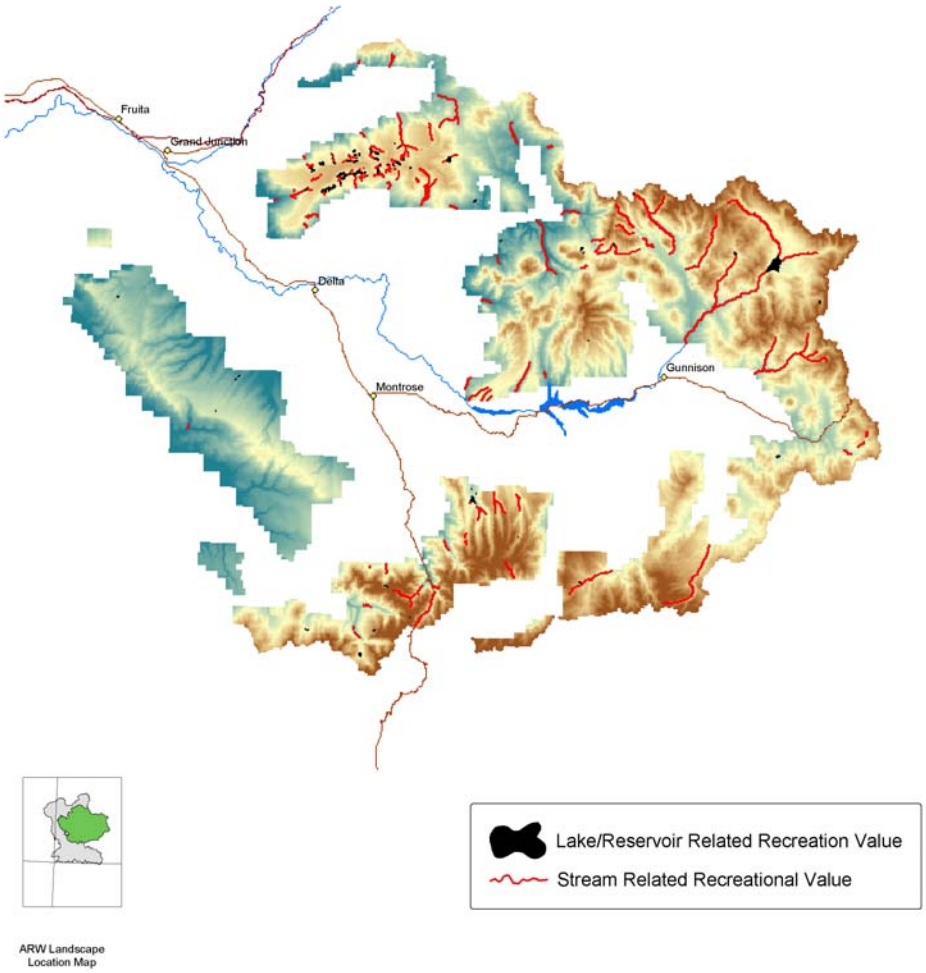
Forest-wide 30 sub-watersheds include lake or reservoir related recreational values with an aerial extent of approximately 5,000 surface acres. Some recreational use is recognized in each of the Geographic Analysis Areas, the complete distribution is summarized in Table 5E9-2. The Grand Mesa, which is well noted for its abundance of

scenic reservoirs, has the greatest overall number, while the Gunnison Analysis Area has the largest surface area extent due to the presence of Taylor Park Reservoir.

Table 5E9-2. Lake and Reservoir Related Recreational Attractions.

Geographic Analysis Area	Number	Total Surface Acres
Grand Mesa	59	1,896
San Juans	17	498
Gunnison	13	2,197
Uncompahgre	8	38
North Fork	7	393

Figure 5E9-1. Water Related Recreational Attractions.



Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Recreational Fishing

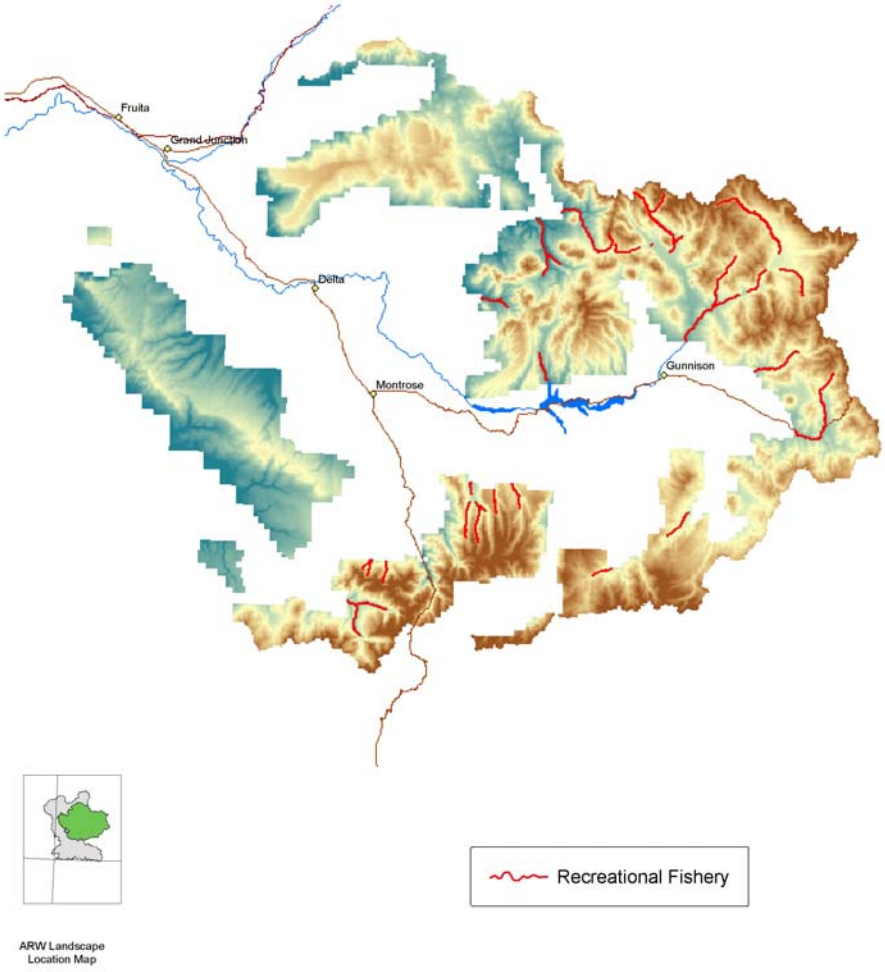
Waters on the GMUG support popular cool and cold water fisheries including Rainbow, Brown, Brook, and Colorado River Cutthroat trout. Forest Service and Colorado Division of Wildlife biologists identified stream segments regularly used by anglers. It is based on frequency of use and does not include any measures of success rate, sizes taken, or anglers per mile. The identified segments were then used to estimate the stream miles currently supporting notable recreational fishing. The segments identified are portrayed in Figure 5E10-1.

Forest-wide, 17 sub-watersheds provide for recreational fishing use along approximately 250 miles of stream. The total stream miles range from a high of about 20 miles on Anthracite Creek, to 0.0 in 198 sub-watershed. The sub-watersheds with 10 or more stream miles identified are listed in Table 5E10-1 below.

Table 5E10-1. Sub-watersheds with Ten or More Stream Miles of Recreational Fishing

Geographic Area	HUC	Watershed	Stream Miles
North Fork	140200040701	Anthracite Creek	20.1
San Juan	140200028101	Cimarron River	20.0
Gunnison	140200039103	Upper Tomichi Creek	18.0
Gunnison	140200019501	Lower Taylor River Comp.	17.5
Gunnison	140200019907	Mid East River Comp.	15.2
North Fork	140200040702	Coal Creek	13.9
Gunnison	140200019509	Upper Taylor River	13.1
Gunnison	140200019505	Spring Creek	11.4
Gunnison	140200039301	Lower Quartz Creek Comp.	10.4
Gunnison	140200019507	Willow Creek	10.1

Figure 5E10-1. Popular Recreational Fishing Streams.



Chapter 5. Sub-Watershed Condition Assessment – Forest Scale

Values

Water Uses

The withdrawal and storage of surface water for agricultural, industrial, and municipal purposes provides social and economic value to the public and are recognized as beneficial uses of water in the State of Colorado. There are approximately 1,600 privately held water rights and an additional 2,400 federal water rights (largely for stock watering purposes) within the GMUG boundaries that are administered by the Colorado Division of Water Resources (CDWR) (see Figure 5E11-1). Development has occurred in approximately 158 sub-watersheds across the Forest. The remaining 65 sub-watersheds that are currently undeveloped produce little water or pose other limitations to development.

In addition, the Colorado Water Conservation Board (CWCB) holds instream flow water rights on approximately 1,100 miles of stream in 77 sub-watersheds across the Forest (see Figure 5E11-1). The quantity and timing of those flows varies by individual stream, but the CWCB program objective is to "preserve and improve the natural environment to a reasonable degree".

Direct withdrawal use records (ditches, pipelines, etc.) are available from the CDWR. The period 1970 to 2000 was used to determine average annual direct withdrawals in each sub-watershed. The reported quantities likely underestimate total withdrawals because CDWR does not collect use records for all diversions. Generally, the small volume diversions are not routinely monitored for use. Over all, there are 147 sub-watersheds incurring direct withdrawals (66% of 223), and use records are available for 122. Quantities range from 3 to over 16,700 acre-feet annually, and the forest-wide total averages approximately 208,500 acre-feet which is about 7.5% of the total runoff generated on the Forest.

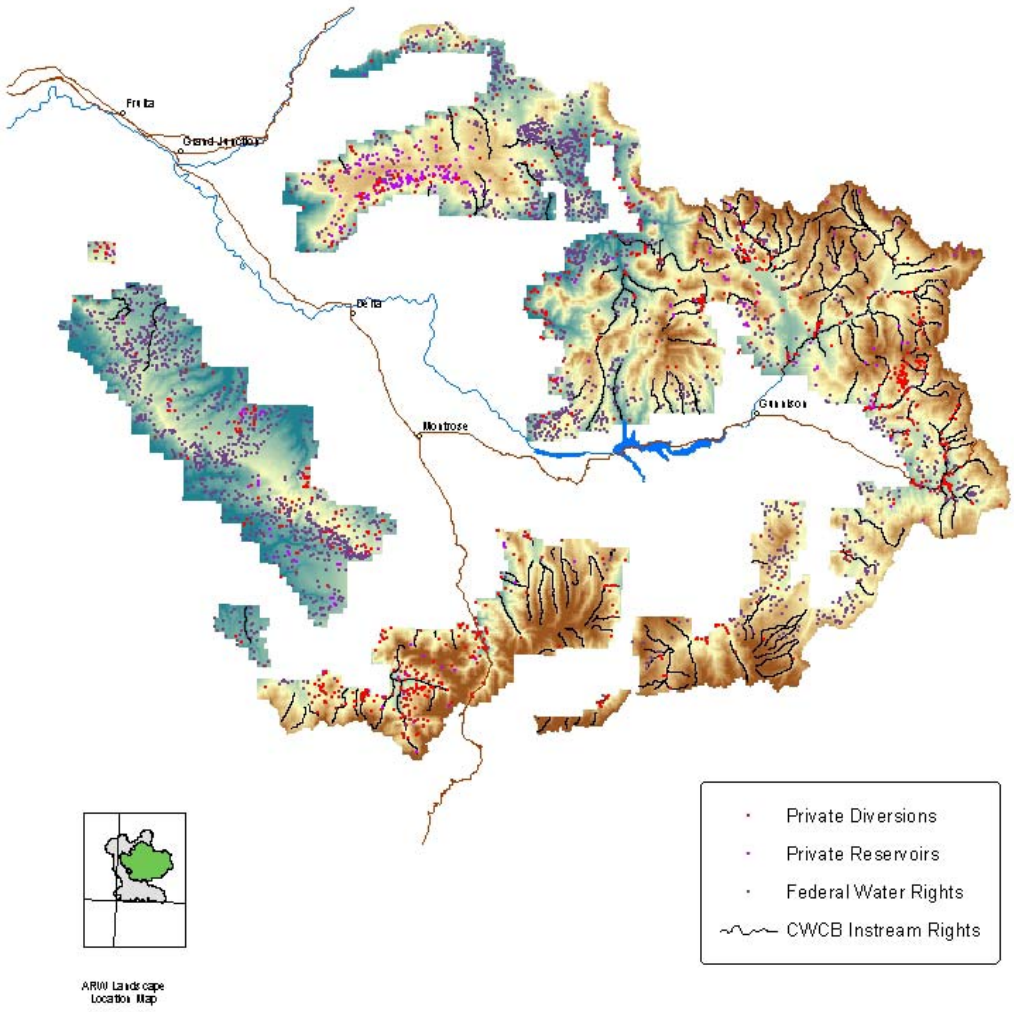
The economic and or social value of a volume of water diverted is difficult to quantify, and beyond the scope of this assessment. Some diversions, regardless of the total volume, provide greater social value because of the number of users that rely upon the water (e.g. municipal drinking water supplies), while others provide greater economic value based upon agricultural outputs. There is insufficient data available to make those types of value assessments at this scale of analysis.

The top 10% of sub-watersheds, based on estimated annual use, is listed below in Table 5E11-1.

Table 5E11-1. GMUG Sub-watersheds with the Most Water Diverted

Geographic Area	HUC	Watershed	Acre-Feet Diverted
San Juan	140300034701	Beaver Creek	16,736
Gunnison	140200039103	Upper Tomichi Creek	14,017
San Juan	140300036304	South Fork San Miguel River	13,479
Gunnison	140200019907	Mid East River Comp.	13,303
Gunnison	140200039301	Lower Quartz Creek Comp.	9,146
North Fork	140200020501	Smith Fork	8,097
Gunnison	140200025401	Gunnison River Comp.	7,505
Gunnison	140200038901	Mid Tomichi Creek Comp.	6,152
Gunnison	140200038702	Los Pinos Creek	5,616
Gunnison	140200028502	Upper Cebolla Creek	4,439
San Juan	140300036308	Fall Creek	4,341
San Juan	140200064801	Upper Cow Ck	3,942

Figure 5E11-1. Private and Federal Water Rights.



Appendix A

PHYSICAL SENSITIVITY VARIABLES

Potential Soil Erosion Hazard – Determined based on the combination of the weighted surface soil Kw factor and slope from the NRCS Soil Survey Manual as follows:

	Percent slope[2]			
	Slight	Moderate	Severe	Very Severe
Kw factor[1]				
Kw < 0.35	0-14	15-35	36-50	>50
Kw >= 0.35	0-9	10-25	26-40	>40

[1] Source for Kw factors NRCS Soil Surveys.
[2] Source of slope data: 30-m DEM.

Weighted Kw was determined based on individual Kw values and relative proportions of the major soil components for each soil mapping unit.

High Runoff Potential – Determined based on available soil surveys. The relative % of each Map Unit in the high runoff class (Group D) was determined based on the extent of soil components in Group D comprising the map unit.

"RUSLE" R Factor – A weighted average calculated for the GMUG portion of each sub-watershed.

Stream Density – Total stream channel miles divided by the sub-watershed area in square miles. The total stream mileage includes all intermittent & perennial, as well as 'crenulated' channels added during the R2 IRI-CWU projects.

Low Gradient Response Segments – Based on the Forest Service Integrated Resource Inventory procedure of valley segment delineation using 1989 1:24,000 areal phototography. Selected segments met the following combination of criteria: stream order >= 3, alluvial channel material (active floodplain), Rosgen stream type of C, D, or E, and channel gradient < 1.5%.

MANAGEMENT ACTIVITY VARIABLES

Vegetation Treatments – Three sources; RMACT, buffered utility corridors, and cleared ski runs.

RMACT – Post 1954 activities were selected from the GMUG RMACT database and GIS theme. Canopy treatments (tree & brush) were selected based on the ACTIVITY_CODE field (Natural Fuels Chipping 1124, Non-Structural Range Improvements – Brush Treatment 2910 and 2920, Regeneration Harvest - Clearcutting 4111-4113, Shelterwood Prep Cuts 4121 & 4122, Selection Cuts 4151 & 4152, Commercial Thinning 4220, Salvage 4231 & 4232, Mechanical Site Prep 4470 and 4474, and Non-Structural Habitat Improvements – Mechanical 6106, Dwarf Mistletoe Control 8102). Acres treated were based on the GIS representation of area, NOT the tabular data associated with each activity polygon. GIS areas may be larger than the actual area treated on the ground, and therefore be an overestimate. This occurs far and away to the largest degree on the Gunnison Ranger District.

Utility corridors – Major corridors (excludes the 'local') were used with a forest wide average width of 150 feet. Only portions that occurred on forested and large brush PNV cover-types were used.

Ski runs – **Forested** portions of ski runs, from the forest ski run cover.

Mine Density – Obtained from the GMUG Abandoned Mine Land Inventory GIS layer. The inventory was done by the Colorado Geological Survey for the Forest Service from 1995 to 1999. "USFS-Abandoned Mine Land Inventory Project Summary Report for the Uncompahgre NF Ouray RD." Fehlman,1997. A "FIELD GUIDE" for the inventory project is available and contains attribute definitions.

Mine adits (holes) and tailing piles (piles) were summed by 6th level HUC.

'Blue Line' Stream Miles below Ditch Diversions – Active diversion points (573 total, where STRTYPE = "1" and CIU = "A,U") from the 2001 state 'structures' GIS coverage (co_wtrrts) was used as a base. The original state data for location is based on a legal location (TRS description in the filing), for that reason some assignments may be in error (not the 'as built location').

The total length of perennial or intermittent stream was identified to the next downstream tributary of the same or greater order, or the GMUG boundary whichever occurred first.

The initial stream segments were then cross checked using the CDSS (Colorado Decision Support System) records system and a GMUG inventory of diversion structures to make warranted adjustments to identified stream segments.

'Blue Line' Stream Miles Affected by Reservoirs – All perennial or intermittent stream segments **<u>below</u>** reservoirs >= 50 surface acres (22 total), were identified to the next downstream tributary of the same or greater order, or the GMUG

boundary. Miles **inundated** were also identified based on straight-line "connector" (CFF 404) paths.

Average Diversion as Percent of Yield – Several sources used to estimate the percent of annual water yield diverted (simple ratio of diversions/yield x 100). No adjustments for return flows are made.

Annual water yield - Based on regression relationships published in Kircher (1985), e (GMUG falls within 3 of Kirchers geoclimatic zones). Yields are from National Forest Lands only. Composite watershed yields were adjusted from the original estimates by summing all upstream yields minus (-) upstream diversions.

Average annual diversions - Digital "use" records from the mid 1970s through year 2000 were supplied by Division 4 which includes total use, as well as monthly use, max Q observed, FDU, DWC etc by structure and by year. Only records with source code = "1" (natural stream flow") were summarized. Structure types included 1-ditch, 4-spring, 5-seep, 7-pipeline and various combinations. (Access strtype criteria: Not Like "*3*" And Not Like "*2*" And Not Like "*P*" And Not Like "*0*"). A count of the records by structure type that are included in the calculation is attached.

Similar digital data was not available for Division 5 structures (Plateau Creek). Therefore, hardcopies of the Division 5 structures were printed from the CDSS Internet site, total annual use by structure by year was loaded in an MS Access format for analysis. All Division 5 structures were assumed to be with source code = "1" (natural stream flow").

Total annual usage was then summed for all structures in a watershed. The number of structures included in the sum for a watershed varies for a particular year. The "Mean Historic Use" was the calculated average based upon all years where the use > 0.

High Streamside Recreational Use – Two sources of information used; Reaches identified during the Pathfinder In-Stream Flow project, and streams near developed recreation sites not identified in the Pathfinder results.

Pathfinder Reaches - District recreation specialists identified high use stream corridors. All stream segments (A1 & A2 - High Use, C- Dispersed Use) are included for this analysis.

Developed Recreation Sites – Developed recreation sites within 100 meters of a stream (GMUG stream coverage) not identified during the Pathfinder project were included. A total of ¼ mile was assumed to be potentially affected for this analysis.

Private Inholdings – The GMUG ALP coverage was used, and percent of the HUC6 within the Forest Boundary in private ownership calculated.

Motorized Route Impacts – The GMUG Infra coverage (Sept 2004) was used to create a GIS coverage (gmug_moto) of all motorized trails and roads.

The motorized routes were used to calculate a general HUC6 motorized route density (route mi/ sq mi).

Motorized route crossing density was determined based on the intersection of the motorized route cover and the total stream network.

Buffered Riparian motorized route density was determined by buffering the gmug riparian coverage by 100 feet and adding 100 foot buffers for any portions of perennial or intermittent channels not within the initial riparian buffer.

Wildfire – The GMUG wildfire coverage was used. Information is available from approximately the mid 1970s on, for fires >= approximately 5 acres. The best information is for larger fires sized fires (>100 acres). Watersheds with 25 % or more of the National Forest area burned within the last 5 years are placed in the highest sensitivity class.

State 303d Listed Streams – Streams listed as impaired by the State of Colorado (2004) were delineated on the GMUG GIS stream coverage. Watersheds with any listed segments are placed in the highest sensitivity class.

VALUES VARIABLES

Water Yield – Annual yield based on Kircher estimates (GMUG falls within 3 of Kirchers geoclimatic zones). Yields are from National Forest Lands only.

Private Diversion Rights w/ CIU of A or U (Direct Withdrawals) – "Active" diversion sites. Point covers provided by Water Divisions 4&5. Essentially, spatial versions of the State of Colo. "structures" database. Point locations are decreed legal locations not necessarily the actual/ or 'as built' locations. Watershed locations were assigned by combining with the GMUG watershed cover. Only records with with CIU (Current in Use) of A (active with records) or U (active w/o records [insignificant or small use]) and a Source Code of 1 (Natural Streamflow) are included. A count of the records included by structure type is attached. The same structure type criteria was used as in the 'Average Annual Diversion' calculation. (Access strtype criteria: [Not Like "*3*" And Not Like "*2*" And Not Like "*P*" And Not Like "*0*"] OR Like "1*3*"). Ditches are then separated from seep/spring developments and combinations.

NOTE: Active rights from co_wtrrts include 19 points within 1 mile of forest boundary (outside) with CIU of A or U. (3 wells, 5 ditches, 4 spring/seeps, 2 = '0')

Reservoirs w/ CIU of A or U – "Active" reservoirs. Point covers provided by Water Divisions 4&5. Essentially, spatial versions of the State of Colo. "structures" database. Point locations are decreed legal locations not necessarily the actual/ or 'as built' locations. Watershed locations were assigned by combining with the GMUG watershed cover. Records where structure type is a reservoir but not ditch-reservoir combinations (Access strtype criteria: [Like "*3*" and not Like "1*3*"]. Only records with with CIU (Current in Use) of A (active with records) or U (active w/o records [insignificant or small use] are included.

Forest Service Water Rights and Uses – Consumptive water rights and uses. Largely springs and pond developments for livestock, some administrative and recreational site wells and springs.

Existing CWCB Claims – A GIS cover was created in 1997 based on the tabular descriptions available from the Internet site. The base GIS GMUG 1:24,000 stream cover was used. It includes only CWCB claims within the GMUG boundaries. The cover was updated January 2002.

Average Annual Diversion – Digital "use" records from the mid 1970s through year 2000 were supplied by Division 4 which includes total use, as well as monthly use, max Q observed, FDU, DWC etc by structure and by year. Only records with source code = "1" (natural stream flow") were summarized. Structure types included 1-ditch, 4-spring, 5-seep, 7-pipeline and various combinations. (Access strtype criteria: Not Like "*3*" And Not Like "*2*" And Not Like "*P*" And Not Like "*0*"). A count of the records by structure type that are included in the calculation is attached.

Similar digital data was not available for Division 5 structures (Plateau Creek). Therefore, hardcopies of the Division 5 structures were printed from the CDSS Internet site, total annual use by structure by year was loaded in an MS Access format for analysis. All Division 5 structures were assumed to be with source code = "1" (natural stream flow").

Total annual usage was then summed for all structures in a watershed. The number of structures included in the sum for a watershed varies for a particular year. The "Mean Historic Use" was the calculated average based upon all years where the use > 0.

Miles of Cottonwood Stands – Based on the Forest Service 1:24,000 air photo interpreted Integrated Resource Inventory. Stream segments where Narrowleaf Cottonwood (Populas angustifolia) was rated as either dominant or co-dominant. Both CVU and CWU sources were used. CVU was transferred to 1:2400 stream coverage.

Colorado River Cutthroat Trout populations – 2004 update of CRCT status and distribution by the representatives of the agency signatories to "The Conservation Agreement for Colorado River Cutthroat Trout in the States of Colorado, Utah, and Wyoming..

Boreal toad populations – Obtained originally from the State of Colorado DOW in November 2004.

Adjustable Channels – Same stream segments used for the Low Gradient Response Segments physical sensitivity factor above.

Public Water Supplies – Developed by GMUG based on Arc shapefiles received from the Colorado Department of Public Health.

Recreational Fishery – Identified on GMUG GIS base map by Chris James and Dan Braugh biologists with USFS and DOW. Reflects frequent use by anglers regardless of success rate.

Recreation related water features – District recreation staff were requested to identify both stream segments and point locations meeting the following criteria were identified:

"A" - High Recreation Use

> "A1" - Streams experience heavy public use during most weekends throughout the recreation season with occasional weekday use or,
>
> "A2" - Stream is located adjacent to another high use recreation feature such as (but not limited to) a trail or campground.
>
> "A3" - stream is ***clearly visible*** from a developed vista site or regionally/nationally designated trail or byway.

"B" - Unique Recreation Attraction – Stream or water feature (e.g. waterfall) is unique to the geographic area; amount of public use is inconsequential. Stream offers high scenic

quality or a unique recreation experience or activity such as kayaking, rafting or education.

"C" - Dispersed Recreation Use – Stream or water feature experiences some dispersed recreation use yet is limited to occasional or seasonal use (hunter camps).

Stream segments were identified on the GMUG GIS stream, lakes & reservoir, and water points covers.

Appendix B - Watershed Sensitivity Variables

HUC5	HUC5 NAME	HUC6	HUC6 NAME	NF Acres	% NF	wtd R factor	stnd R	stream density	stnd stream density	% severe & v severe erosion r	stnd erosion risk	% hydrologic group D	stnd hydrologic group D	% adjustable channels	stnd adjustable channels	sum stnd	class
1401000517	Plateau Ck	140100051701	Lower Plateau C	6,013	10	140	0.37	8.90	1.00	0.55	0.64	0.96	0.97	0.00	0.00	2.98	4
		140100051702	Anderson Gulch	3,656	42	143	0.38	7.58	0.85	0.68	0.80	0.90	0.91	0.00	0.00	2.94	4
		140100051703	Kimball Ck	4,783	66	229	0.61	4.91	0.55	0.40	0.47	0.41	0.42	0.00	0.00	2.05	4
		140100051704	Mid Plateau Ck C	491	4	249	0.67	0.00	0.00	0.10	0.12	0.00	0.00	0.00	0.00	0.78	1
		140100051705	Upper Plateau Ck	9,577	83	325	0.87	3.21	0.36	0.08	0.10	0.08	0.08	0.05	0.29	1.69	3
		140100051706	Park Ck	5,381	91	294	0.79	3.68	0.41	0.13	0.15	0.38	0.38	0.06	0.37	2.10	4
		140100051707	Leon Ck	27,684	96	344	0.92	4.00	0.45	0.05	0.05	0.22	0.22	0.01	0.05	1.69	3
		140100051708	Salt Ck	2,358	19	246	0.66	2.26	0.25	0.39	0.46	0.08	0.08	0.00	0.00	1.45	2
		140100051709	Grove Ck	6,115	50	263	0.70	1.99	0.22	0.17	0.20	0.09	0.09	0.00	0.00	1.22	2
		140100051710	Big Ck	15,468	93	305	0.82	3.07	0.34	0.07	0.08	0.17	0.17	0.02	0.10	1.51	3
		140100051711	Deacon Gulch	390	6	245	0.66	0.00	0.00	0.50	0.58	0.04	0.04	0.00	0.00	1.27	2
		140100051712	Cottonwood Ck	10,679	76	284	0.76	2.32	0.26	0.18	0.21	0.09	0.09	0.00	0.00	1.32	2
		140100051713	Bull Ck	9,257	62	286	0.77	1.53	0.17	0.10	0.12	0.15	0.15	0.00	0.00	1.20	2
		140100051714	Spring Ck	2,532	29	222	0.59	2.23	0.25	0.01	0.01	0.12	0.12	0.00	0.00	0.97	1
		140100051715	Coon Ck	3,758	33	252	0.68	1.80	0.20	0.10	0.12	0.26	0.26	0.00	0.00	1.26	2
		140100051716	Mesa Ck	7,677	37	261	0.70	1.76	0.20	0.19	0.22	0.13	0.13	0.00	0.00	1.24	2
1401000519	Buzzard Ck	140100051901	Lower Buzzard C	11,542	30	226	0.61	4.08	0.46	0.20	0.24	0.11	0.11	0.00	0.00	1.41	2
		140100051902	Harrison Ck	1,986	29	246	0.66	3.87	0.43	0.16	0.19	0.00	0.00	0.00	0.00	1.28	2
		140100051903	Hawxhurst Ck	6,608	68	245	0.66	4.10	0.46	0.18	0.21	0.08	0.08	0.00	0.00	1.40	2
		140100051904	Brush Ck	8,380	74	238	0.64	4.77	0.54	0.43	0.51	0.12	0.12	0.00	0.00	1.80	3
		140100051905	Road Gulch	6,603	81	197	0.53	5.13	0.58	0.13	0.15	0.05	0.05	0.00	0.00	1.30	2
		140100051906	Upper Buzzard Ck	45,725	99	292	0.78	3.44	0.39	0.02	0.02	0.03	0.03	0.06	0.38	1.60	3
1402000195	Taylor Rvr	140200019501	Lower Taylor Rvr C	38,325	98	198	0.53	3.49	0.39	0.41	0.48	0.38	0.38	0.00	0.00	1.78	3
		140200019502	Beaver Ck	18,335	100	222	0.59	4.34	0.49	0.17	0.20	0.30	0.30	0.02	0.14	1.72	3
		140200019503	Crystal Ck	14,314	100	252	0.67	2.25	0.25	0.37	0.43	0.27	0.27	0.00	0.03	1.66	3
		140200019504	Lottis Ck	26,975	100	250	0.67	2.31	0.26	0.40	0.47	0.28	0.28	0.06	0.37	2.05	4
		140200019505	Spring Ck	43,940	100	222	0.59	2.70	0.30	0.30	0.35	0.29	0.29	0.02	0.16	1.70	3
		140200019506	Mid Taylor Rvr C	56,061	100	238	0.64	2.65	0.30	0.18	0.20	0.14	0.14	0.06	0.41	1.69	3
		140200019507	Willow Ck	40,620	100	263	0.70	2.48	0.28	0.26	0.31	0.25	0.25	0.09	0.55	2.09	4

Appendix B - Watershed Sensitivity Variables

		140200019508	Texas Ck	25,945	100	328	0.88	1.82	0.21	0.38	0.44	0.15	0.15	0.13	0.84	2.51	4
		140200019509	Upper Taylor Rvr	39,910	100	272	0.73	2.48	0.28	0.31	0.37	0.27	0.27	0.07	0.46	2.10	4
1402000199	East Rvr	140200019901	Lower East Rvr C	10,829	46	226	0.61	2.81	0.32	0.24	0.28	0.14	0.15	0.05	0.35	1.70	3
		140200019902	Roaring Judy Ck	6,035	65	230	0.62	3.05	0.34	0.29	0.34	0.24	0.24	0.00	0.00	1.54	3
		140200019903	Alkali Ck	7,413	80	258	0.69	3.61	0.41	0.11	0.12	0.03	0.03	0.00	0.00	1.25	2
		140200019904	Cement Ck	21,953	97	255	0.68	3.33	0.37	0.47	0.55	0.27	0.27	0.03	0.17	2.05	4
		140200019905	Farris Ck	4,267	90	267	0.72	2.51	0.28	0.38	0.44	0.24	0.24	0.08	0.48	2.16	4
		140200019906	Brush Ck	24,673	100	297	0.80	2.94	0.33	0.52	0.61	0.17	0.17	0.03	0.21	2.12	4
		140200019907	Mid East Rvr C	15,769	96	287	0.77	3.47	0.39	0.36	0.42	0.20	0.20	0.16	1.00	2.78	4
		140200019908	Slate Rvr	45,688	79	293	0.78	2.38	0.27	0.45	0.52	0.15	0.15	0.05	0.31	2.03	4
		140200019909	Copper Ck	5,886	100	374	1.00	2.64	0.30	0.68	0.80	0.17	0.17	0.00	0.00	2.27	4
		140200019910	Upper East Rvr	11,334	100	366	0.98	3.17	0.36	0.55	0.65	0.18	0.18	0.05	0.31	2.47	4
1402000201	Ohio Ck	140200020101	Lower Ohio Ck C	16,593	44	185	0.49	2.99	0.34	0.06	0.07	0.03	0.03	0.00	0.00	0.93	1
		140200020102	Willow Ck	3,229	43	247	0.66	4.00	0.45	0.02	0.03	0.00	0.00	0.00	0.00	1.14	2
		140200020103	Carbon Ck	11,952	75	272	0.73	3.15	0.35	0.25	0.29	0.00	0.00	0.04	0.25	1.63	3
		140200020104	Upper Ohio Ck	7,769	90	298	0.80	2.53	0.28	0.37	0.43	0.04	0.04	0.00	0.00	1.55	3
		140200020105	Pass Ck	6,487	92	273	0.73	2.56	0.29	0.13	0.15	0.05	0.05	0.00	0.00	1.22	2
		140200020106	Castle Ck	14,099	97	247	0.66	3.50	0.39	0.36	0.42	0.08	0.08	0.07	0.44	2.00	4
		140200020107	Mill Ck	8,407	79	237	0.63	3.78	0.42	0.56	0.65	0.03	0.03	0.01	0.09	1.83	3
1402000203	Soap/Antelope Cks C	140200020301	Soap Ck	51,802	98	219	0.59	4.07	0.46	0.55	0.65	0.09	0.10	0.03	0.19	1.98	4
		140200020302	West Elk Ck	19,072	97	262	0.70	4.82	0.54	0.71	0.83	0.15	0.15	0.00	0.00	2.23	4
		140200020303	Red Ck	4,963	54	267	0.72	3.06	0.34	0.31	0.36	0.16	0.16	0.00	0.00	1.58	3
		140200020304	Dry Gulch	74	2	177	0.47	0.00	0.00	0.00	0.00	0.35	0.35	0.00	0.00	0.82	1
		140200020305	East Elk Ck	10,231	71	263	0.70	4.07	0.46	0.48	0.56	0.17	0.17	0.00	0.00	1.89	3
		140200020306	Dry Ck	171	5	161	0.43	1.27	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.57	1
		140200020307	Willow Ck	4,627	61	252	0.67	3.47	0.39	0.28	0.33	0.17	0.17	0.00	0.00	1.56	3
		140200020308	Stevens Ck	2,881	52	202	0.54	2.69	0.30	0.15	0.18	0.13	0.13	0.00	0.00	1.15	2
		140200020309	Steuben Ck	13,322	80	231	0.62	3.17	0.36	0.43	0.51	0.10	0.10	0.00	0.00	1.59	3
		140200020310	Beaver Ck	17,286	75	246	0.66	3.81	0.43	0.62	0.72	0.09	0.09	0.01	0.08	1.98	4
		140200020311	Antelope Ck	4,492	21	192	0.51	3.47	0.39	0.31	0.36	0.14	0.14	0.00	0.00	1.41	2
1402000205	Smith Fk/Crawford Res.	140200020501	Smith Fk	37,451	83	200	0.54	4.14	0.47	0.52	0.61	0.03	0.03	0.02	0.10	1.75	3
		140200020502	Muddy Ck	5,229	12	191	0.51	2.94	0.33	0.23	0.27	0.03	0.03	0.00	0.00	1.14	2
1402000207	Blue Mesa Res./Upper Gunnison Rvr C	140200020704	Blue Mesa Res. C	795	1	213	0.57	4.63	0.52	0.62	0.73	0.03	0.03	0.00	0.00	1.85	3
1402000210	BlaCk Canyon C	140200021001	Spring/Pool Gulches C	13	0	160	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	1
1402000249	Blue/Pine Cks	140200024901	Big Blue	27,470	76	193	0.52	2.55	0.29	0.50	0.59	0.26	0.26	0.07	0.45	2.11	4
		140200024902	Little Blue	2,521	34	162	0.43	1.90	0.21	0.08	0.10	0.01	0.01	0.00	0.00	0.75	1
		140200024903	Pine Ck	120	4	132	0.35	1.21	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.49	1
1402000250	South Beaver Ck	140200025001	Upper South Beaver	16,589	77	227	0.61	1.68	0.19	0.08	0.09	0.12	0.12	0.00	0.00	1.01	1
		140200025002	Lower South Beaver	387	2	159	0.43	2.16	0.24	0.00	0.00	0.52	0.53	0.00	0.00	1.19	2
1402000253	Crystal/Curecanti Cks C	140200025301	Crystal Ck C	29,757	80	220	0.59	3.11	0.35	0.30	0.35	0.04	0.04	0.01	0.06	1.39	2

Appendix B - Watershed Sensitivity Variables

		140200025302	Long Gulch	1,940	96	217	0.58	2.75	0.31	0.27	0.32	0.05	0.05	0.00	0.00	1.25	2
		140200025303	Mesa Ck	7,126	84	228	0.61	2.51	0.28	0.06	0.07	0.00	0.00	0.00	0.00	0.97	1
		140200025304	Myers Gulch	3,427	58	226	0.60	2.64	0.30	0.01	0.01	0.01	0.01	0.00	0.00	0.92	1
		140200025305	Curecanti Ck	21,136	84	226	0.60	3.55	0.40	0.51	0.60	0.05	0.05	0.06	0.37	2.02	4
		140200025306	Corral Ck	1,687	43	208	0.56	3.07	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.90	1
		140200025307	Haypress Ck	649	37	207	0.55	2.86	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.88	1
		140200025308	Cottonwood Gulch	1,233	34	192	0.51	2.69	0.30	0.01	0.01	0.00	0.00	0.00	0.00	0.83	1
1402000254	Gunnison Rvr C	140200025401	Gunnison Rvr C	5,632	27	159	0.42	3.93	0.44	0.06	0.07	0.08	0.08	0.08	0.53	1.54	3
		140200025402	Leaps Gulch	5,852	83	208	0.56	3.29	0.37	0.04	0.05	0.05	0.05	0.00	0.00	1.03	1
		140200025403	Fischer Gulch	2,629	100	193	0.52	3.03	0.34	0.03	0.04	0.11	0.11	0.00	0.00	1.01	1
1402000281	Cimarron Rvr	140200028101	Cimarron Rvr	46,322	56	228	0.61	4.49	0.50	0.55	0.64	0.29	0.30	0.02	0.14	2.20	4
		140200028102	Little Cimarron Rvr	17,645	34	218	0.58	3.21	0.36	0.49	0.57	0.18	0.18	0.03	0.18	1.88	3
1402000283	Lake Fk Gunnison Rvr	140200028301	Lower Lake Fk C	33,943	40	154	0.41	2.68	0.30	0.45	0.52	0.30	0.30	0.00	0.02	1.56	3
		140200028302	Hensen Ck	18,408	58	220	0.59	3.26	0.37	0.61	0.71	0.33	0.33	0.00	0.00	1.99	4
		140200028303	Upper Lake Fk	19,861	41	244	0.65	2.46	0.28	0.50	0.58	0.47	0.47	0.03	0.16	2.15	4
		140200028304	Willow Ck	1,948	25	128	0.34	1.50	0.17	0.06	0.07	0.03	0.03	0.00	0.00	0.61	1
1402000285	Cebolla Ck	140200028501	Rock Ck/Fish Canyon C	5,501	11	191	0.51	3.18	0.36	0.02	0.02	0.06	0.06	0.00	0.00	0.95	1
		140200028502	Upper Cebolla Ck	97,690	89	204	0.55	2.59	0.29	0.28	0.33	0.24	0.24	0.02	0.14	1.54	3
		140200028503	Powderhorn Ck	646	5	204	0.54	0.99	0.11	0.00	0.00	0.22	0.23	0.00	0.00	0.88	1
1402000351	Razor Ck	140200035101	Upper Razor Ck	22,203	88	205	0.55	2.71	0.30	0.29	0.34	0.39	0.39	0.05	0.29	1.88	3
		140200035102	Prosser Ck	2,547	57	163	0.44	3.39	0.38	0.21	0.25	0.34	0.34	0.00	0.00	1.40	2
		140200035103	Lower Razor Ck C	1,270	9	111	0.30	1.93	0.22	0.12	0.14	0.30	0.30	0.00	0.00	0.96	1
1402000387	Cochetopa Ck	140200038701	Upper Cochetopa Ck	82,959	78	199	0.53	2.27	0.25	0.18	0.21	0.21	0.21	0.05	0.34	1.54	3
		140200038702	Los Pinos Ck	43,020	77	191	0.51	2.91	0.33	0.10	0.12	0.17	0.17	0.03	0.19	1.32	2
		140200038703	West Pass Ck	27,621	89	178	0.48	3.29	0.37	0.11	0.12	0.29	0.29	0.04	0.24	1.50	3
		140200038704	Lower Cochetopa Ck C	10,562	18	158	0.42	2.14	0.24	0.13	0.15	0.21	0.21	0.00	0.00	1.02	1
1402000389	Lower Tomichi Ck C	140200038901	Mid Tomichi Ck C	47,245	70	184	0.49	3.75	0.42	0.30	0.35	0.23	0.23	0.03	0.16	1.66	3
		140200038902	Hot Spring Ck	21,241	74	217	0.58	3.23	0.36	0.12	0.14	0.06	0.06	0.04	0.24	1.38	2
		140200038903	Wood Gulch	2,163	29	179	0.48	4.90	0.55	0.02	0.02	0.00	0.00	0.00	0.00	1.05	1
		140200038904	Sewell Gulch	1,651	32	173	0.46	3.11	0.35	0.09	0.10	0.17	0.17	0.00	0.00	1.08	2
		140200038905	Cabin Ck	3,823	55	196	0.52	3.21	0.36	0.01	0.01	0.02	0.02	0.00	0.00	0.92	1
		140200038906	Stubbs Gulch	2,605	61	151	0.40	3.15	0.35	0.00	0.00	0.39	0.39	0.00	0.00	1.15	2
		140200038907	Lower Tomichi C	222	1	173	0.46	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.52	1
1402000391	Upper Tomichi Ck	140200039101	Long Branch Ck	15,490	100	233	0.62	2.58	0.29	0.34	0.39	0.31	0.31	0.02	0.13	1.76	3
		140200039102	Marshall Ck	36,632	100	282	0.75	2.65	0.30	0.21	0.25	0.11	0.11	0.06	0.37	1.78	3
		140200039103	Upper Tomichi Ck	58,230	100	319	0.85	3.41	0.38	0.34	0.40	0.06	0.06	0.07	0.46	2.15	4
1402000393	Quartz Ck	140200039301	Lower Quartz Ck C	24,534	79	228	0.61	3.76	0.42	0.38	0.44	0.33	0.34	0.07	0.45	2.25	4
		140200039302	Alder Ck	7,990	73	224	0.60	3.63	0.41	0.24	0.28	0.34	0.34	0.00	0.00	1.63	3
		140200039303	Gold Ck	19,457	100	295	0.79	2.68	0.30	0.49	0.57	0.36	0.37	0.00	0.00	2.03	4
		140200039304	Upper Quartz Ck	25,919	100	346	0.93	2.57	0.29	0.50	0.58	0.31	0.31	0.03	0.18	2.29	4

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1402000407	Anthracite Ck	140200040701	Anthracite Ck	80,009	95	261	0.70	3.51	0.39	0.43	0.50	0.13	0.13	0.01	0.07	1.79	3
		140200040702	Coal Ck	64,655	100	203	0.54	3.93	0.44	0.47	0.55	0.13	0.13	0.01	0.09	1.75	3
1402000409	East Muddy Ck	140200040901	Lower East Muddy Ck C	17,378	54	249	0.67	5.87	0.66	0.32	0.37	0.09	0.09	0.00	0.00	1.79	3
		140200040902	Lee Ck	12,532	91	257	0.69	5.28	0.59	0.19	0.22	0.06	0.06	0.00	0.00	1.56	3
		140200040903	Clear Fk East Muddy Ck	24,694	100	275	0.74	3.52	0.40	0.20	0.24	0.03	0.04	0.02	0.13	1.53	3
		140200040904	Little Muddy Ck	10,395	100	257	0.69	4.67	0.53	0.16	0.19	0.00	0.00	0.01	0.08	1.48	3
		140200040905	Little Henderson Ck	5,296	99	209	0.56	7.13	0.80	0.07	0.08	0.00	0.00	0.00	0.00	1.44	2
1402000411	North Fk Gunnison Rvr C	140200041101	North Fk Gunnison Rvr C	24,172	42	190	0.51	3.71	0.42	0.40	0.46	0.18	0.18	0.00	0.00	1.57	3
		140200041102	Minnesota Ck	23,910	69	197	0.53	4.36	0.49	0.34	0.40	0.05	0.05	0.00	0.00	1.47	3
		140200041103	Terror Ck	13,992	74	318	0.85	3.32	0.37	0.07	0.09	0.00	0.00	0.00	0.00	1.31	2
		140200041104	Paonia Reservoir C	5,846	38	270	0.72	4.79	0.54	0.32	0.37	0.04	0.04	0.00	0.00	1.67	3
1402000455	West Muddy Ck	140200045501	Lower West Muddy Ck C	23,356	75	210	0.56	3.38	0.38	0.10	0.11	0.02	0.02	0.00	0.00	1.07	2
		140200045502	Upper West Muddy Ck	20,240	100	303	0.81	3.52	0.40	0.04	0.04	0.06	0.06	0.02	0.11	1.41	2
		140200045503	Cow Ck	11,599	100	346	0.93	3.22	0.36	0.04	0.04	0.10	0.10	0.00	0.00	1.43	2
1402000456	Hubbard Ck	140200045601	Lower Hubbard Ck C	8,599	51	230	0.61	2.80	0.31	0.31	0.37	0.16	0.16	0.00	0.00	1.46	3
		140200045602	Upper Hubbard Ck	13,052	100	337	0.90	2.93	0.33	0.03	0.04	0.10	0.10	0.03	0.17	1.55	3
		140200045603	Alder Ck	5,676	81	277	0.74	2.56	0.29	0.06	0.07	0.02	0.02	0.00	0.00	1.12	2
1402000458	Leroux/Cottonwood Cks C	140200045801	East Leroux Ck	22,383	79	371	0.99	3.25	0.37	0.04	0.05	0.06	0.06	0.00	0.00	1.46	3
		140200045803	West Roatcap Ck	311	5	339	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	1
		140200045806	Reynolds Ck	1,948	29	190	0.51	4.45	0.50	0.43	0.50	0.01	0.01	0.00	0.00	1.52	3
		140200045807	Cottonwood Ck	4,882	32	150	0.40	3.71	0.42	0.21	0.25	0.03	0.03	0.00	0.00	1.09	2
		140200045808	Bell Ck	2,986	15	179	0.48	2.83	0.32	0.43	0.50	0.00	0.00	0.00	0.00	1.30	2
1402000509	Wells/Alkali Cks C	140200050901	Petrie Mesa	40	0	213	0.57	0.00	0.00	0.12	0.14	0.00	0.00	0.00	0.00	0.71	1
		140200050902	Alkali Ck	2,297	11	239	0.64	3.12	0.35	0.15	0.18	0.05	0.05	0.00	0.00	1.22	2
		140200050905	Wells Gulch	3,443	44	175	0.47	5.17	0.58	0.28	0.33	0.15	0.15	0.00	0.00	1.53	3
1402000513	Tongue/Currant Cks C	140200051301	Dry Gulch	1,011	16	233	0.62	1.02	0.11	0.10	0.12	0.06	0.06	0.00	0.00	0.92	1
		140200051302	Negro Ck	54	1	190	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	1
		140200051303	Doughspoon Ck	2,552	37	210	0.56	1.46	0.16	0.12	0.14	0.15	0.15	0.00	0.00	1.02	1
		140200051304	Oak Ck	4,838	34	228	0.61	2.10	0.24	0.07	0.08	0.12	0.12	0.00	0.00	1.04	1
		140200051305	Dirty George Ck	9,698	58	258	0.69	1.92	0.22	0.08	0.10	0.07	0.07	0.00	0.00	1.07	2
		140200051306	Ward Ck	9,076	71	283	0.76	1.76	0.20	0.09	0.11	0.07	0.07	0.00	0.00	1.13	2
		140200051307	Kiser Ck	8,884	41	293	0.78	2.49	0.28	0.07	0.08	0.07	0.07	0.00	0.00	1.21	2
		140200051308	Milk Ck	3,021	55	346	0.93	3.63	0.41	0.09	0.10	0.02	0.02	0.00	0.00	1.45	3
		140200051309	Surface Ck	16,757	69	367	0.98	4.01	0.45	0.06	0.07	0.06	0.06	0.00	0.00	1.56	3
		140200051310	Currant Ck	7,369	42	317	0.85	3.47	0.39	0.04	0.05	0.01	0.01	0.00	0.00	1.30	2
1402000515	Kannah/Whitewater Cks C	140200051501	Kannah Ck	49,460	57	239	0.64	2.61	0.29	0.09	0.11	0.31	0.31	0.00	0.00	1.36	2
		140200051502	Whitewater Ck	3,522	11	248	0.66	2.09	0.24	0.19	0.23	0.30	0.31	0.00	0.00	1.43	2
		140200051503	Deer Ck	1,885	31	163	0.44	6.04	0.68	0.19	0.22	0.06	0.06	0.00	0.00	1.40	2
1402000540	East Ck	140200054001	Upper East Ck	1,634	26	158	0.42	1.86	0.21	0.05	0.06	0.51	0.51	0.00	0.00	1.20	2
		140200054002	Gibbler Gulch	475	6	158	0.42	1.76	0.20	0.00	0.00	0.85	0.85	0.00	0.00	1.47	3

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		140200054003	North East Ck	3,258	42	199	0.53	2.71	0.30	0.03	0.04	0.00	0.00	0.00	0.00	0.88	1
		140200054005		7	0	157	0.42	0.00	0.00	0.00	0.00	0.19	0.19	0.00	0.00	0.61	1
1402000573	Dominguez Ck	140200057301	Big Dominguez	33,223	64	194	0.52	2.88	0.32	0.04	0.05	0.22	0.22	0.05	0.32	1.43	2
		140200057302	Little Dominguez	22,562	63	206	0.55	3.59	0.40	0.05	0.06	0.17	0.17	0.01	0.07	1.26	2
1402000575	Escalante Ck	140200057501	Escalante Ck (Ouray & G.V.)	54,756	96	236	0.63	2.65	0.30	0.20	0.23	0.25	0.25	0.06	0.39	1.80	3
		140200057502	N Fk Escalante Ck	19,063	76	223	0.60	2.95	0.33	0.14	0.16	0.14	0.14	0.04	0.26	1.49	3
		140200057503	Dry Fk Escalante Ck	16,197	75	225	0.60	2.29	0.26	0.10	0.12	0.28	0.28	0.02	0.15	1.41	2
		140200057504		24	0	145	0.39	0.00	0.00	0.00	0.00	0.56	0.56	0.00	0.00	0.95	1
1402000577	Roubideau Ck	140200057701	Roubideau Ck	51,795	85	189	0.50	3.28	0.37	0.17	0.20	0.37	0.38	0.03	0.17	1.61	3
		140200057702	Potter Ck	21,886	61	225	0.60	2.60	0.29	0.09	0.11	0.28	0.29	0.00	0.00	1.29	2
		140200057703	Cottonwood Ck	9,613	46	249	0.67	2.47	0.28	0.06	0.07	0.11	0.11	0.00	0.00	1.13	2
1402000640	Spring Ck/Happy Canyon C	140200064001	Spring Ck	17,878	46	186	0.50	2.09	0.23	0.09	0.10	0.15	0.15	0.03	0.17	1.15	2
		140200064002	Happy Canyon Ck	6,554	27	150	0.40	2.29	0.26	0.03	0.03	0.26	0.26	0.00	0.00	0.96	1
		140200064003	Horsefly Ck	11	0	177	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	1
1402000648	Cow Ck	140200064801	Upper Cow Ck	28,320	89	232	0.62	4.80	0.54	0.69	0.81	0.46	0.46	0.01	0.08	2.51	4
		140200064802	Owl Ck	4,238	90	200	0.54	4.33	0.49	0.35	0.41	0.05	0.05	0.00	0.00	1.48	3
		140200064803	Nate Ck	3,270	74	208	0.56	4.73	0.53	0.33	0.39	0.06	0.06	0.00	0.00	1.54	3
		140200064804	Lou Ck	5,263	66	212	0.57	3.74	0.42	0.25	0.29	0.06	0.06	0.00	0.00	1.34	2
		140200064805	Deer Ck	855	24	203	0.54	5.40	0.61	0.21	0.25	0.13	0.13	0.00	0.00	1.53	3
		140200064806	Burro Ck	757	11	215	0.57	6.60	0.74	0.18	0.21	0.00	0.00	0.00	0.00	1.52	3
		140200064807	Lower Cow Ck C	33	0	173	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	1
1402000650	Dry Ck	140200065001	East Fk Dry Ck	16,385	47	210	0.56	2.00	0.23	0.07	0.08	0.09	0.09	0.00	0.00	0.95	1
		140200065002	Coalbank/Big Sandy	2,334	27	127	0.34	0.97	0.11	0.00	0.00	0.92	0.93	0.00	0.00	1.37	2
		140200065003	Roatcap Gulch	1,861	16	105	0.28	1.56	0.17	0.00	0.00	0.62	0.62	0.00	0.00	1.08	2
1402000679	Upper Uncompahgre Rvr	140200067901	Upper Uncompahgre Rvr	63,451	73	228	0.61	4.12	0.46	0.73	0.86	0.56	0.57	0.01	0.09	2.59	4
		140200067902	Dry Ck	1,199	13	171	0.46	3.10	0.35	0.34	0.40	0.08	0.08	0.00	0.00	1.29	2
		140200067903	East Fk Dallas Ck	12,263	63	238	0.64	2.83	0.32	0.57	0.67	0.38	0.38	0.02	0.12	2.13	4
		140200067904	West Fk Dallas Ck	7,240	45	214	0.57	3.51	0.39	0.39	0.46	0.31	0.31	0.00	0.00	1.74	3
1403000171	Little Dolores Rvr	140300017101	Upper Little Dolores Rvr	3,558	32	205	0.55	4.02	0.45	0.07	0.08	0.00	0.00	0.00	0.00	1.08	2
1403000345	Coal/Cottonwood Cks C	140300034501	Cottonwood Ck	29,141	89	189	0.51	3.99	0.45	0.05	0.06	0.28	0.28	0.00	0.00	1.30	2
		140300034502	Bucktail Cks C	8,579	39	174	0.46	3.69	0.41	0.03	0.03	0.37	0.37	0.00	0.00	1.28	2
		140300034503	Tuttle/Bramier Draws C	557	19	137	0.37	5.23	0.59	0.07	0.08	0.49	0.49	0.00	0.00	1.52	3
		140300034505	Coal Ck	4,336	19	141	0.38	5.24	0.59	0.05	0.06	0.46	0.46	0.00	0.00	1.49	3
		140300034507	Atkinson Ck	5,979	31	183	0.49	5.19	0.58	0.36	0.42	0.36	0.37	0.00	0.00	1.85	3
1403000347	Beaver/Mckenzie Cks C	140300034701	Beaver Ck	28,561	59	310	0.83	3.22	0.36	0.13	0.15	0.09	0.09	0.01	0.05	1.48	3
		140300034702	Saltado Ck	6,271	48	261	0.70	2.37	0.27	0.05	0.06	0.09	0.09	0.04	0.24	1.36	2
		140300034703	Specie Ck	1,044	14	214	0.57	1.30	0.15	0.10	0.11	0.11	0.12	0.00	0.00	0.95	1
		140300034704	McKenzie Ck	15,389	51	159	0.43	2.98	0.33	0.10	0.11	0.40	0.40	0.05	0.29	1.56	3
		140300034705	Clay Ck	15,433	99	162	0.43	3.32	0.37	0.08	0.10	0.39	0.39	0.01	0.05	1.35	2
		140300034706	Beaver McKenzie C	14,680	43	147	0.39	2.89	0.32	0.05	0.06	0.45	0.45	0.01	0.05	1.27	2

Appendix B - Watershed Sensitivity Variables

1403000361	Naturita Ck	140300036101	Naturita Ck	19,497	16	218	0.58	2.32	0.26	0.22	0.26	0.27	0.28	0.11	0.73	2.11	4
		140300036102	McKee Draw	4,337	74	158	0.42	3.28	0.37	0.09	0.11	0.30	0.31	0.00	0.00	1.21	2
		140300036103	Burn Canyon	823	25	140	0.38	2.31	0.26	0.03	0.03	0.32	0.32	0.00	0.00	0.99	1
		140300036104	Callan Draw	5,614	50	158	0.42	3.67	0.41	0.12	0.15	0.43	0.44	0.00	0.00	1.42	2
		140300036105	Hamilton Ck	618	62	168	0.45	2.07	0.23	0.06	0.07	0.34	0.34	0.00	0.00	1.09	2
		140300036106	Maverick Draw	3,236	13	161	0.43	3.12	0.35	0.01	0.02	0.33	0.33	0.00	0.00	1.13	2
1403000363	Upper San Miguel Rvr	140300036301	Mid San Miguel Rvr C	3,636	17	206	0.55	1.71	0.19	0.69	0.81	0.20	0.20	0.00	0.00	1.76	3
		140300036302	Leopard Ck	7,507	36	211	0.57	3.71	0.42	0.31	0.36	0.28	0.29	0.00	0.00	1.63	3
		140300036303	Upper San Miguel Rvr C	32,669	100	219	0.59	2.94	0.33	0.62	0.72	0.33	0.33	0.03	0.22	2.19	4
		140300036304	South Fk San Miguel Rvr	37,144	100	223	0.60	2.56	0.29	0.54	0.63	0.32	0.32	0.04	0.26	2.09	4
		140300036305	Deep Ck	9,079	100	212	0.57	2.35	0.26	0.66	0.77	0.31	0.31	0.00	0.00	1.91	3
		140300036306	Bilk Ck	8,095	89	197	0.53	2.89	0.32	0.51	0.60	0.32	0.32	0.00	0.00	1.77	3
		140300036307	Bear Ck	6,431	62	199	0.53	4.38	0.49	0.26	0.30	0.19	0.19	0.00	0.00	1.52	3
		140300036308	Fall Ck	17,232	65	233	0.62	3.47	0.39	0.25	0.29	0.20	0.20	0.00	0.00	1.51	3
1403000365	Horsefly Ck	140300036501	Horsefly Ck C	11,147	93	161	0.43	2.80	0.31	0.31	0.36	0.43	0.44	0.00	0.00	1.55	3
		140300036502	Sheep Ck	4,431	100	197	0.53	2.85	0.32	0.08	0.09	0.18	0.18	0.00	0.00	1.12	2
		140300036503	Red Ck	8,260	100	202	0.54	2.94	0.33	0.25	0.29	0.09	0.09	0.00	0.00	1.24	2
		140300036504	Little Red Canyon	7,875	100	191	0.51	2.48	0.28	0.17	0.20	0.04	0.04	0.00	0.00	1.03	1
		140300036505	Hanks Ck	5,035	100	184	0.49	3.28	0.37	0.10	0.11	0.08	0.08	0.00	0.00	1.05	1
		140300036506	Clear Ck	5,094	100	200	0.54	2.62	0.29	0.09	0.10	0.06	0.07	0.00	0.00	1.00	1
		140300036507	Upper Horsefly Ck	9,539	40	191	0.51	2.76	0.31	0.03	0.03	0.17	0.17	0.02	0.13	1.16	2
		140300036508	Albin Draw	5,659	100	151	0.40	2.52	0.28	0.02	0.03	0.36	0.36	0.08	0.48	1.56	3
1403000367	Tabeguache Ck	140300036701	Tabeguache Ck	47,705	83	244	0.65	3.03	0.34	0.18	0.21	0.24	0.24	0.01	0.09	1.53	3
		140300036702	Shavano Ck	3,646	47	272	0.73	5.88	0.66	0.28	0.33	0.52	0.53	0.00	0.00	2.24	4
		140300036703	Campbell Ck	7,360	41	268	0.72	5.52	0.62	0.30	0.35	0.48	0.48	0.00	0.00	2.17	4
		140300036704	Spring Ck	4,685	35	217	0.58	5.13	0.58	0.41	0.48	0.49	0.49	0.00	0.00	2.12	4
1403000442	Blue Ck	140300044201	Upper Blue Ck	12,660	88	195	0.52	3.36	0.38	0.24	0.28	0.30	0.30	0.00	0.00	1.48	3
		140300044202	Calamity Ck	19,448	64	188	0.50	4.91	0.55	0.16	0.19	0.52	0.53	0.00	0.00	1.77	3
		140300044203	MaveriCk Canyon	2,156	14	153	0.41	5.32	0.60	0.01	0.01	0.67	0.68	0.00	0.00	1.70	3
1403000443	Mesa Ck	140300044301	North Fk Mesa Ck	12,767	36	201	0.54	3.36	0.38	0.23	0.27	0.18	0.18	0.00	0.00	1.37	2
		140300044302	South Fk Mesa Ck	6,463	21	220	0.59	2.77	0.31	0.36	0.42	0.11	0.11	0.00	0.00	1.43	2
1403000469	West Ck	140300046901	Upper West Ck	29,860	49	175	0.47	3.16	0.36	0.29	0.34	0.27	0.27	0.14	0.88	2.32	4
		140300046902	Ute Ck	5,465	25	179	0.48	4.31	0.48	0.36	0.43	0.34	0.34	0.00	0.00	1.73	3
		140300046903	Wright/Casto Draws C	166	1	180	0.48	0.00	0.00	0.85	1.00	0.99	1.00	0.00	0.00	2.48	4

Appendix C - Watershed Activity Variables

HUC5	HUC5_NAME	HUC6	HUC6_NAME	nf acres	% private ownership	stnd % private ownership	% stream network w/ high recreation use	stnd % stream network w/ high recreation use	% blue line streams hydrologic regime change	stnd % blue line streams hydrologic regime char	% canopy treatments	stnd % canopy treatments	mine density	stnd mine density	motorized route density	stnd motorized route density	stnd WIZ density + mor route density	sum stnd	class
1401000517	Plateau Ck	140100051701	Lower Plateau C	6,013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.02	0.09	0.108	1
		140100051702	Anderson Gulch	3,656	0.00	0.00	0.00	0.00	0.11	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.160	4
		140100051703	Kimball Ck	4,783	0.06	0.06	0.02	0.07	0.00	0.01	0.02	0.02	0.00	0.00	0.78	0.09	0.03	0.274	1
		140100051704	Mid Plateau Ck C	491	0.16	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.155	1
		140100051705	Upper Plateau Ck	9,577	0.02	0.02	0.05	0.20	0.03	0.04	0.00	0.00	0.00	0.00	0.27	0.03	0.06	0.351	2
		140100051706	Park Ck	5,381	0.09	0.09	0.00	0.00	0.08	0.12	0.01	0.02	0.00	0.00	0.42	0.05	0.06	0.327	1
		140100051707	Leon Ck	27,684	0.00	0.00	0.10	0.43	0.13	0.18	0.01	0.02	0.00	0.00	0.91	0.10	0.14	0.882	3
		140100051708	Salt Ck	2,358	0.00	0.00	0.00	0.00	0.12	0.18	0.00	0.00	0.00	0.00	0.36	0.04	0.02	0.233	1
		140100051709	Grove Ck	6,115	0.08	0.08	0.00	0.00	0.06	0.09	0.05	0.08	0.00	0.00	0.82	0.09	0.07	0.417	2
		140100051710	Big Ck	15,468	0.04	0.04	0.10	0.42	0.23	0.34	0.20	0.32	0.04	0.00	1.85	0.20	0.22	1.535	4
		140100051711	Deacon Gulch	390	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.00	0.00	0.65	0.07	0.00	0.116	1
		140100051712	Cottonwood Ck	10,679	0.00	0.00	0.09	0.40	0.33	0.48	0.04	0.06	0.00	0.00	1.35	0.15	0.28	1.374	4
		140100051713	Bull Ck	9,257	0.00	0.00	0.09	0.38	0.00	0.00	0.02	0.02	0.00	0.00	0.77	0.08	0.10	0.590	2
		140100051714	Spring Ck	2,532	0.00	0.00	0.00	0.00	0.34	0.49	0.00	0.00	0.00	0.00	0.61	0.07	0.03	0.582	4
		140100051715	Coon Ck	3,758	0.00	0.00	0.02	0.09	0.00	0.00	0.07	0.11	0.34	0.03	1.50	0.16	0.17	0.566	2
		140100051716	Mesa Ck	7,677	0.00	0.00	0.16	0.71	0.11	0.16	0.12	0.19	0.00	0.00	1.23	0.13	0.18	1.371	4
1401000519	Buzzard Ck	140100051901	Lower Buzzard C	11,542	0.00	0.00	0.00	0.00	0.06	0.09	0.01	0.02	0.00	0.00	1.69	0.18	0.31	0.600	2
		140100051902	Harrison Ck	1,986	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.296	1
		140100051903	Hawxhurst Ck	6,608	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07	0.12	0.18	0.292	1
		140100051904	Brush Ck	8,380	0.02	0.02	0.05	0.22	0.03	0.05	0.00	0.00	0.00	0.00	1.32	0.14	0.33	0.757	3
		140100051905	Road Gulch	6,603	0.00	0.00	0.00	0.00	0.11	0.15	0.00	0.01	0.00	0.00	1.55	0.17	0.40	0.734	3
		140100051906	Upper Buzzard Ck	45,725	0.03	0.03	0.06	0.25	0.04	0.06	0.04	0.06	0.00	0.00	1.43	0.16	0.26	0.821	3
1402000195	Taylor Rvr	140200019501	Lower Taylor Rvr C	38,325	0.08	0.08	0.09	0.38	0.15	0.22	0.00	0.01	0.00	0.00	0.93	0.10	0.25	1.026	3
		140200019502	Beaver Ck	18,335	0.11	0.11	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	1.10	0.12	0.20	0.450	2
		140200019503	Crystal Ck	14,314	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.02	0.00	0.00	0.009	1
		140200019504	Lottis Ck	26,975	0.04	0.04	0.01	0.03	0.00	0.00	0.01	0.01	0.05	0.00	0.85	0.09	0.18	0.363	2

Appendix C - Watershed Activity Variables

		140200019505	Spring Ck	43,940	0.02	0.02	0.07	0.29	0.11	0.16	0.06	0.10	0.63	0.05	1.77	0.19	0.31	1.125	3
		140200019506	Mid Taylor Rvr C	56,061	0.07	0.07	0.04	0.18	0.12	0.17	0.06	0.10	0.32	0.03	1.76	0.19	0.23	0.977	3
		140200019507	Willow Ck	40,620	0.08	0.08	0.00	0.01	0.09	0.14	0.03	0.05	3.69	0.31	1.66	0.18	0.25	1.011	3
		140200019508	Texas Ck	25,945	0.00	0.00	0.13	0.56	0.00	0.00	0.01	0.02	1.01	0.08	0.64	0.07	0.10	0.841	3
		140200019509	Upper Taylor Rvr	39,910	0.02	0.02	0.07	0.31	0.00	0.00	0.00	0.00	0.91	0.08	1.00	0.11	0.14	0.655	2
1402000199	East Rvr	140200019901	Lower East Rvr C	10,829	0.11	0.11	0.00	0.00	0.05	0.08	0.00	0.00	0.00	0.00	1.09	0.12	0.18	0.485	2
		140200019902	Roaring Judy Ck	6,035	0.13	0.13	0.00	0.00	0.04	0.07	0.00	0.00	0.74	0.06	1.47	0.16	0.25	0.665	2
		140200019903	Alkali Ck	7,413	0.13	0.13	0.00	0.00	0.05	0.07	0.00	0.00	0.00	0.00	0.56	0.06	0.07	0.327	1
		140200019904	Cement Ck	21,953	0.02	0.02	0.13	0.57	0.09	0.13	0.01	0.02	0.41	0.03	1.68	0.18	0.38	1.328	4
		140200019905	Farris Ck	4,267	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	1.23	0.13	0.22	0.364	2
		140200019906	Brush Ck	24,673	0.01	0.01	0.00	0.00	0.04	0.05	0.00	0.00	0.54	0.05	1.04	0.11	0.20	0.420	2
		140200019907	Mid East Rvr C	15,769	0.14	0.14	0.18	0.77	0.18	0.26	0.02	0.03	0.00	0.00	1.15	0.13	0.18	1.513	4
		140200019908	Slate Rvr	45,688	0.19	0.19	0.08	0.35	0.08	0.11	0.01	0.02	11.21	0.94	1.20	0.13	0.18	1.919	4
		140200019909	Copper Ck	5,886	0.09	0.09	0.22	0.95	0.05	0.07	0.00	0.00	6.52	0.54	0.55	0.06	0.20	1.926	4
		140200019910	Upper East Rvr	11,334	0.03	0.03	0.13	0.57	0.01	0.01	0.00	0.00	7.17	0.60	0.98	0.11	0.21	1.530	4
1402000201	Ohio Ck	140200020101	Lower Ohio Ck C	16,593	0.14	0.14	0.00	0.00	0.02	0.03	0.02	0.02	0.00	0.00	1.03	0.11	0.15	0.468	2
		140200020102	Willow Ck	3,229	0.27	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.05	1.40	0.15	0.26	0.726	3
		140200020103	Carbon Ck	11,952	0.15	0.15	0.00	0.00	0.02	0.03	0.00	0.00	1.18	0.10	0.87	0.10	0.15	0.527	2
		140200020104	Upper Ohio Ck	7,769	0.13	0.13	0.01	0.04	0.11	0.15	0.03	0.04	0.74	0.06	0.86	0.09	0.14	0.662	2
		140200020105	Pass Ck	6,487	0.04	0.04	0.00	0.00	0.08	0.12	0.00	0.00	0.20	0.02	0.08	0.01	0.00	0.184	1
		140200020106	Castle Ck	14,099	0.00	0.00	0.00	0.00	0.03	0.04	0.00	0.00	0.18	0.02	0.25	0.03	0.03	0.113	1
		140200020107	Mill Ck	8,407	0.04	0.04	0.01	0.02	0.03	0.04	0.01	0.02	0.00	0.00	0.74	0.08	0.11	0.319	1
1402000203	Soap/Antelope Cks C	140200020301	Soap Ck	51,802	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.00	0.43	0.05	0.11	0.218	1
		140200020302	West Elk Ck	19,072	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.11	0.01	0.01	0.030	1
		140200020303	Red Ck	4,963	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.18	0.00	0.00	2.89	0.32	0.79	1.280	4
		140200020304	Dry Gulch	74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
		140200020305	East Elk Ck	10,231	0.01	0.01	0.00	0.02	0.00	0.00	0.10	0.17	0.00	0.00	1.87	0.20	0.17	0.570	2
		140200020306	Dry Ck	171	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.00	0.00	9.06	0.99	1.00	2.053	4
		140200020307	Willow Ck	4,627	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.35	0.00	0.00	3.16	0.34	0.37	1.069	3
		140200020308	Stevens Ck	2,881	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.48	0.27	0.42	0.692	2
		140200020309	Steuben Ck	13,322	0.04	0.04	0.00	0.00	0.02	0.03	0.00	0.00	0.38	0.03	1.05	0.11	0.21	0.419	2
		140200020310	Beaver Ck	17,286	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.03	0.01	0.044	1
		140200020311	Antelope Ck	4,492	0.00	0.00	0.00	0.00	0.02	0.03	0.25	0.41	0.00	0.00	2.46	0.27	0.45	1.158	3
1402000205	Smith Fk/Crawford Res.	140200020501	Smith Fk	37,451	0.01	0.01	0.01	0.05	0.03	0.04	0.01	0.02	0.17	0.01	0.18	0.02	0.03	0.190	1
		140200020502	Muddy Ck	5,229	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.13	0.00	0.00	0.73	0.08	0.20	0.409	2
1402000207	Blue Mesa Res./Upper Gunnison Rvr C	140200020704	Blue Mesa Res. C	795	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.09	0.05	0.139	1
1402000210	BlaCk Canyon C	140200021001	Spring/Pool Gulches C	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
1402000249	Blue/Pine Cks	140200024901	Big Blue	27,470	0.00	0.00	0.04	0.15	0.00	0.00	0.01	0.01	0.00	0.00	0.36	0.04	0.08	0.287	1
		140200024902	Little Blue	2,521	0.00	0.00	0.00	0.00	0.00	0.00	0.61	1.00	0.00	0.00	2.39	0.26	0.30	1.561	4
		140200024903	Pine Ck	120	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	2.63	0.29	0.00	0.310	1
1402000250	South Beaver Ck	140200025001	Upper South Beaver	16,589	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.31	0.03	0.08	0.124	1
		140200025002	Lower South Beaver	387	0.16	0.16	0.00	0.00	0.00	0.00	0.23	0.38	0.00	0.00	0.00	0.00	0.00	0.542	2
1402000253	Crystal/Curecanti Cks C	140200025301	Crystal Ck C	29,757	0.04	0.04	0.00	0.00	0.03	0.05	0.10	0.16	0.00	0.00	0.74	0.08	0.11	0.441	2

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		140200025302	Long Gulch	1,940	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.15	0.00	0.00	1.86	0.20	0.12	0.472	2
		140200025303	Mesa Ck	7,126	0.02	0.02	0.00	0.00	0.39	0.56	0.13	0.22	0.00	0.00	1.51	0.16	0.22	1.181	3
		140200025304	Myers Gulch	3,427	0.05	0.05	0.00	0.00	0.00	0.00	0.13	0.22	0.00	0.00	1.63	0.18	0.30	0.739	3
		140200025305	Curecanti Ck	21,136	0.03	0.03	0.06	0.25	0.02	0.02	0.05	0.08	0.00	0.00	0.31	0.03	0.08	0.507	2
		140200025306	Corral Ck	1,687	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	0.16	0.50	0.658	2
		140200025307	Haypress Ck	649	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.34	0.48	0.821	3
		140200025308	Cottonwood Gulch	1,233	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.19	0.39	0.578	2
1402000254	Gunnison Rvr C	140200025401	Gunnison Rvr C	5,632	0.24	0.24	0.08	0.36	0.13	0.18	0.00	0.00	0.00	0.00	2.93	0.32	0.44	1.548	4
		140200025402	Leaps Gulch	5,852	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.19	0.23	0.658	2
		140200025403	Fischer Gulch	2,629	0.18	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.05	0.22	0.33	0.724	3
1402000281	Cimarron Rvr	140200028101	Cimarron Rvr	46,322	0.00	0.00	0.02	0.10	0.07	0.10	0.02	0.04	0.11	0.01	0.77	0.08	0.10	0.429	2
		140200028102	Little Cimarron Rvr	17,645	0.00	0.00	0.08	0.35	0.00	0.00	0.09	0.15	0.00	0.00	0.95	0.10	0.18	0.788	3
1402000283	Lake Fk Gunnison Rvr	140200028301	Lower Lake Fk C	33,943	0.01	0.01	0.00	0.00	0.06	0.09	0.00	0.01	0.00	0.00	0.22	0.02	0.03	0.163	1
		140200028302	Hensen Ck	18,408	0.00	0.00	0.04	0.18	0.00	0.00	0.00	0.00	1.01	0.08	0.57	0.06	0.13	0.463	2
		140200028303	Upper Lake Fk	19,861	0.05	0.05	0.00	0.01	0.06	0.09	0.00	0.00	0.58	0.05	0.29	0.03	0.04	0.279	1
		140200028304	Willow Ck	1,948	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.11	0.00	0.00	1.59	0.17	0.19	0.475	2
1402000285	Cebolla Ck	140200028501	Rock Ck/Fish Canyon C	5,501	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	1.01	0.11	0.27	0.388	2
		140200028502	Upper Cebolla Ck	97,690	0.01	0.01	0.03	0.12	0.02	0.03	0.04	0.06	0.14	0.01	0.59	0.06	0.10	0.397	2
		140200028503	Powderhorn Ck	646	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
1402000351	Razor Ck	140200035101	Upper Razor Ck	22,203	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.72	0.06	1.33	0.15	0.32	0.607	2
		140200035102	Prosser Ck	2,547	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.28	0.52	0.96	0.10	0.26	0.892	3
		140200035103	Lower Razor Ck C	1,270	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.53	0.29	2.36	0.26	0.80	1.348	4
1402000387	Cochetopa Ck	140200038701	Upper Cochetopa Ck	82,959	0.01	0.01	0.00	0.01	0.05	0.08	0.07	0.11	0.06	0.01	1.23	0.13	0.20	0.545	2
		140200038702	Los Pinos Ck	43,020	0.01	0.01	0.00	0.00	0.03	0.04	0.10	0.17	0.00	0.00	1.18	0.13	0.21	0.558	2
		140200038703	West Pass Ck	27,621	0.02	0.02	0.00	0.00	0.03	0.05	0.13	0.21	2.15	0.18	2.29	0.25	0.54	1.241	4
		140200038704	Lower Cochetopa Ck C	10,562	0.02	0.02	0.00	0.00	0.05	0.08	0.00	0.00	1.82	0.15	1.13	0.12	0.12	0.495	2
1402000389	Lower Tomichi Ck C	140200038901	Mid Tomichi Ck C	47,245	0.07	0.07	0.00	0.00	0.05	0.07	0.00	0.00	0.24	0.02	1.35	0.15	0.45	0.772	3
		140200038902	Hot Spring Ck	21,241	0.20	0.20	0.00	0.00	0.03	0.05	0.21	0.34	0.96	0.08	2.61	0.28	0.47	1.427	4
		140200038903	Wood Gulch	2,163	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	1.48	0.12	1.73	0.19	0.33	0.664	2
		140200038904	Sewell Gulch	1,651	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.10	0.13	0.231	1
		140200038905	Cabin Ck	3,823	0.21	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12	0.23	0.17	0.608	2
		140200038906	Stubbs Gulch	2,605	0.12	0.12	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	1.30	0.14	0.14	0.421	2
		140200038907	Lower Tomichi C	222	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.10	0.34	0.00	0.338	1
1402000391	Upper Tomichi Ck	140200039101	Long Branch Ck	15,490	0.01	0.01	0.00	0.00	0.06	0.08	0.01	0.02	0.00	0.00	1.01	0.11	0.28	0.502	2
		140200039102	Marshall Ck	36,632	0.09	0.09	0.03	0.14	0.07	0.11	0.08	0.13	1.00	0.08	2.25	0.25	0.37	1.171	3
		140200039103	Upper Tomichi Ck	58,230	0.12	0.12	0.00	0.00	0.10	0.14	0.03	0.05	2.26	0.19	1.33	0.15	0.25	0.893	3
1402000393	Quartz Ck	140200039301	Lower Quartz Ck C	24,534	0.26	0.26	0.07	0.31	0.09	0.13	0.04	0.07	3.26	0.27	1.83	0.20	0.34	1.576	4
		140200039302	Alder Ck	7,990	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.06	1.63	0.18	0.39	0.635	2
		140200039303	Gold Ck	19,457	0.19	0.19	0.10	0.45	0.09	0.13	0.01	0.02	5.03	0.42	1.28	0.14	0.33	1.675	4
		140200039304	Upper Quartz Ck	25,919	0.10	0.10	0.13	0.56	0.00	0.00	0.08	0.13	3.19	0.27	2.04	0.22	0.43	1.698	4
1402000407	Anthracite Ck	140200040701	Anthracite Ck	80,009	0.06	0.06	0.02	0.09	0.02	0.02	0.01	0.01	2.74	0.23	0.44	0.05	0.07	0.527	2
		140200040702	Coal Ck	64,655	0.01	0.01	0.03	0.14	0.01	0.01	0.00	0.00	0.14	0.01	0.12	0.01	0.03	0.220	1
1402000409	East Muddy Ck	140200040901	Lower East Muddy Ck C	17,378	0.08	0.08	0.01	0.03	0.04	0.06	0.00	0.00	0.00	0.00	0.15	0.02	0.04	0.233	1

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		140200040902	Lee Ck	12,532	0.08	0.08	0.01	0.06	0.02	0.03	0.00	0.00	0.00	0.00	0.54	0.06	0.09	0.320	1
		140200040903	Clear Fk East Muddy Ck	24,694	0.01	0.01	0.03	0.11	0.05	0.07	0.00	0.01	0.00	0.00	0.12	0.01	0.03	0.246	1
		140200040904	Little Muddy Ck	10,395	0.11	0.11	0.00	0.00	0.08	0.12	0.02	0.03	0.00	0.00	0.58	0.06	0.11	0.427	2
		140200040905	Little Henderson Ck	5,296	0.09	0.09	0.00	0.00	0.07	0.10	0.01	0.02	0.00	0.00	1.34	0.15	0.48	0.826	3
1402000411	North Fk Gunnison Rvr C	140200041101	North Fk Gunnison Rvr C	24,172	0.04	0.04	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.87	0.09	0.14	0.286	1
		140200041102	Minnesota Ck	23,910	0.13	0.13	0.01	0.05	0.04	0.06	0.00	0.00	0.21	0.02	1.27	0.14	0.26	0.665	2
		140200041103	Terror Ck	13,992	0.00	0.00	0.02	0.09	0.06	0.08	0.06	0.10	0.00	0.00	1.66	0.18	0.29	0.743	3
		140200041104	Paonia Reservoir C	5,846	0.00	0.00	0.00	0.00	0.13	0.18	0.00	0.00	0.00	0.00	0.45	0.05	0.09	0.320	4
1402000455	West Muddy Ck	140200045501	Lower West Muddy Ck C	23,356	0.07	0.07	0.00	0.00	0.06	0.09	0.00	0.00	0.00	0.00	0.62	0.07	0.17	0.407	2
		140200045502	Upper West Muddy Ck	20,240	0.07	0.07	0.00	0.00	0.05	0.07	0.00	0.01	0.03	0.00	1.00	0.11	0.16	0.421	2
		140200045503	Cow Ck	11,599	0.03	0.03	0.04	0.17	0.29	0.42	0.00	0.01	0.06	0.00	0.69	0.08	0.07	0.781	3
1402000456	Hubbard Ck	140200045601	Lower Hubbard Ck C	8,599	0.03	0.03	0.00	0.00	0.03	0.04	0.01	0.01	0.00	0.00	0.77	0.08	0.20	0.367	2
		140200045602	Upper Hubbard Ck	13,052	0.04	0.04	0.00	0.00	0.10	0.15	0.04	0.07	0.00	0.00	0.88	0.10	0.14	0.497	2
		140200045603	Alder Ck	5,676	0.05	0.05	0.00	0.00	0.00	0.00	0.11	0.19	0.00	0.00	1.74	0.19	0.22	0.646	2
1402000458	Leroux/Cottonwood Cks C	140200045801	East Leroux Ck	22,383	0.01	0.01	0.15	0.65	0.01	0.01	0.02	0.03	0.00	0.00	0.75	0.08	0.12	0.892	3
		140200045803	West Roatcap Ck	311	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20	0.24	0.00	0.239	1
		140200045806	Reynolds Ck	1,948	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.03	0.10	0.136	1
		140200045807	Cottonwood Ck	4,882	0.02	0.02	0.00	0.00	0.18	0.26	0.01	0.02	0.00	0.00	0.35	0.04	0.04	0.379	4
		140200045808	Bell Ck	2,986	0.11	0.11	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.52	0.06	0.15	0.340	1
1402000509	Wells/Alkali Cks C	140200050901	Petrie Mesa	40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.10	0.45	0.00	0.447	2
		140200050902	Alkali Ck	2,297	0.00	0.00	0.00	0.00	0.06	0.08	0.00	0.00	0.00	0.00	0.54	0.06	0.13	0.272	1
		140200050905	Wells Gulch	3,443	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.11	0.01	0.02	0.046	1
1402000513	Tongue/Currant Cks C	140200051301	Dry Gulch	1,011	0.00	0.00	0.00	0.00	0.69	1.00	0.00	0.00	0.00	0.00	1.37	0.15	0.04	1.188	4
		140200051302	Negro Ck	54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.66	0.29	0.00	0.290	1
		140200051303	Doughspoon Ck	2,552	0.00	0.00	0.20	0.88	0.07	0.10	0.00	0.00	0.00	0.00	1.99	0.22	0.18	1.372	4
		140200051304	Oak Ck	4,838	0.01	0.01	0.23	1.00	0.08	0.12	0.00	0.00	0.00	0.00	1.57	0.17	0.18	1.475	4
		140200051305	Dirty George Ck	9,698	0.00	0.00	0.06	0.25	0.23	0.33	0.02	0.02	0.00	0.00	0.94	0.10	0.11	0.819	3
		140200051306	Ward Ck	9,076	0.02	0.02	0.08	0.34	0.45	0.65	0.01	0.02	0.00	0.00	1.49	0.16	0.12	1.316	4
		140200051307	Kiser Ck	8,884	0.02	0.02	0.18	0.77	0.41	0.60	0.18	0.30	0.00	0.00	1.94	0.21	0.27	2.164	4
		140200051308	Milk Ck	3,021	0.00	0.00	0.00	0.00	0.05	0.08	0.03	0.05	0.00	0.00	1.36	0.15	0.07	0.352	2
		140200051309	Surface Ck	16,757	0.00	0.00	0.11	0.48	0.12	0.17	0.03	0.05	0.00	0.00	1.31	0.14	0.23	1.077	3
		140200051310	Currant Ck	7,369	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.02	0.06	0.081	1
1402000515	Kannah/Whitewater Cks C	140200051501	Kannah Ck	49,460	0.00	0.00	0.04	0.19	0.09	0.14	0.10	0.16	0.05	0.00	0.82	0.09	0.08	0.659	2
		140200051502	Whitewater Ck	3,522	0.00	0.00	0.00	0.00	0.09	0.13	0.06	0.10	0.00	0.00	1.05	0.11	0.02	0.367	2
		140200051503	Deer Ck	1,885	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
1402000540	East Ck	140200054001	Upper East Ck	1,634	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01	0.22	0.23	0.445	2
		140200054002	Gibbler Gulch	475	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.25	0.25	0.08	0.326	1
		140200054003	North East Ck	3,258	0.14	0.14	0.02	0.08	0.09	0.13	0.00	0.00	0.00	0.00	0.86	0.09	0.09	0.535	2
		140200054005		7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.17	1.00	0.00	1.000	3
1402000573	Dominguez Ck	140200057301	Big Dominguez	33,223	0.07	0.07	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.00	1.50	0.16	0.14	0.405	2
		140200057302	Little Dominguez	22,562	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.07	0.00	0.00	0.87	0.09	0.10	0.263	1
1402000575	Escalante Ck	140200057501	Escalante Ck (Ouray & GV)	54,756	0.03	0.03	0.00	0.00	0.01	0.01	0.09	0.14	0.00	0.00	1.03	0.11	0.17	0.470	2
		140200057502	N Fk Escalante Ck	19,063	0.11	0.11	0.00	0.00	0.07	0.09	0.02	0.03	0.00	0.00	0.71	0.08	0.06	0.367	2

Appendix C - Watershed Activity Variables

		140200057503	Dry Fk Escalante Ck	16,197	0.01	0.01	0.00	0.00	0.03	0.05	0.17	0.28	0.00	0.00	2.18	0.24	0.18	0.751	3
		140200057504		24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
1402000577	Roubideau Ck	140200057701	Roubideau Ck	51,795	0.01	0.01	0.00	0.00	0.02	0.03	0.08	0.13	0.00	0.00	1.85	0.20	0.17	0.542	2
		140200057702	Potter Ck	21,886	0.06	0.06	0.00	0.01	0.09	0.13	0.14	0.23	0.00	0.00	2.46	0.27	0.22	0.919	3
		140200057703	Cottonwood Ck	9,613	0.01	0.01	0.00	0.00	0.16	0.24	0.11	0.17	0.00	0.00	2.73	0.30	0.23	0.944	3
1402000640	Spring Ck/Happy Canyon C	140200064001	Spring Ck	17,878	0.06	0.06	0.00	0.00	0.00	0.00	0.22	0.35	0.00	0.00	3.16	0.34	0.28	1.033	3
		140200064002	Happy Canyon Ck	6,554	0.29	0.29	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	2.92	0.32	0.28	0.925	3
		140200064003	Horsefly Ck	11	1.06	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.063	3
1402000648	Cow Ck	140200064801	Upper Cow Ck	28,320	0.02	0.02	0.01	0.04	0.01	0.01	0.00	0.01	0.38	0.03	0.17	0.02	0.04	0.166	1
		140200064802	Owl Ck	4,238	0.02	0.02	0.00	0.00	0.01	0.01	0.01	0.02	0.00	0.00	1.69	0.18	0.42	0.662	2
		140200064803	Nate Ck	3,270	0.11	0.11	0.00	0.00	0.00	0.00	0.03	0.04	0.00	0.00	1.95	0.21	0.35	0.718	3
		140200064804	Lou Ck	5,263	0.22	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.06	0.09	0.369	2
		140200064805	Deer Ck	855	0.22	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.222	1
		140200064806	Burro Ck	757	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.73	0.19	0.64	1.133	3
		140200064807	Lower Cow Ck C	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
1402000650	Dry Ck	140200065001	East Fk Dry Ck	16,385	0.22	0.22	0.01	0.04	0.12	0.17	0.23	0.37	0.00	0.00	3.35	0.37	0.27	1.440	4
		140200065002	Coalbank/Big Sandy	2,334	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.21	0.00	0.00	8.74	0.95	0.68	1.837	4
		140200065003	Roatcap Gulch	1,861	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.16	0.00	0.00	6.89	0.75	0.32	1.231	4
1402000679	Upper Uncompahgre Rvr	140200067901	Upper Uncompahgre Rvr	63,451	0.25	0.25	0.02	0.10	0.05	0.07	0.00	0.00	11.97	1.00	0.93	0.10	0.18	1.701	4
		140200067902	Dry Ck	1,199	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1
		140200067903	East Fk Dallas Ck	12,263	0.04	0.04	0.04	0.17	0.03	0.04	0.04	0.07	0.99	0.08	0.79	0.09	0.14	0.619	2
		140200067904	West Fk Dallas Ck	7,240	0.14	0.14	0.01	0.04	0.03	0.05	0.00	0.01	0.00	0.00	0.88	0.10	0.18	0.515	2
1403000171	Little Dolores Rvr	140300017101	Upper Little Dolores Rvr	3,558	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.99	0.11	0.06	0.196	1
1403000345	Coal/Cottonwood Cks C	140300034501	Cottonwood Ck	29,141	0.07	0.07	0.00	0.00	0.08	0.11	0.12	0.20	0.00	0.00	1.94	0.21	0.28	0.879	3
		140300034502	Bucktail Cks C	8,579	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.44	0.00	0.00	2.58	0.28	0.32	1.041	4
		140300034503	Tuttle/Bramier Draws C	557	0.19	0.19	0.00	0.00	0.00	0.00	0.04	0.06	0.00	0.00	2.35	0.26	0.00	0.506	2
		140300034505	Coal Ck	4,336	0.10	0.10	0.00	0.00	0.00	0.00	0.07	0.12	0.00	0.00	1.42	0.15	0.31	0.687	2
		140300034507	Atkinson Ck	5,979	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.12	0.38	0.497	2
1403000347	Beaver/Mckenzie Cks C	140300034701	Beaver Ck	28,561	0.05	0.05	0.00	0.00	0.18	0.26	0.09	0.15	0.00	0.00	1.32	0.14	0.15	0.752	4
		140300034702	Saltado Ck	6,271	0.70	0.70	0.00	0.00	0.23	0.33	0.01	0.02	0.00	0.00	1.23	0.13	0.09	1.276	4
		140300034703	Specie Ck	1,044	0.31	0.31	0.00	0.00	0.30	0.43	0.00	0.00	0.00	0.00	0.89	0.10	0.00	0.839	3
		140300034704	McKenzie Ck	15,389	0.19	0.19	0.00	0.00	0.03	0.05	0.07	0.12	0.00	0.00	2.09	0.23	0.25	0.844	3
		140300034705	Clay Ck	15,433	0.11	0.11	0.00	0.00	0.00	0.00	0.10	0.16	0.00	0.00	2.09	0.23	0.27	0.769	3
		140300034706	Beaver McKenzie C	14,680	0.01	0.01	0.00	0.00	0.00	0.00	0.14	0.23	0.00	0.00	2.50	0.27	0.26	0.773	3
1403000361	Naturita Ck	140300036101	Naturita Ck	19,497	0.04	0.04	0.00	0.00	0.04	0.06	0.16	0.25	0.00	0.00	1.72	0.19	0.09	0.628	2
		140300036102	McKee Draw	4,337	0.14	0.14	0.00	0.00	0.00	0.00	0.44	0.72	0.00	0.00	2.95	0.32	0.72	1.894	4
		140300036103	Burn Canyon	823	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.67	0.00	0.00	2.92	0.32	0.28	1.269	4
		140300036104	Callan Draw	5,614	0.01	0.01	0.00	0.00	0.00	0.00	0.13	0.22	0.00	0.00	2.59	0.28	0.24	0.745	4
		140300036105	Hamilton Ck	618	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.68	0.62	0.83	1.453	4
		140300036106	Maverick Draw	3,236	0.46	0.46	0.00	0.00	0.00	0.00	0.24	0.39	0.00	0.00	2.10	0.23	0.25	1.330	4
1403000363	Upper San Miguel Rvr	140300036301	Mid San Miguel Rvr C	3,636	0.20	0.20	0.00	0.00	0.11	0.16	0.00	0.00	1.23	0.10	0.71	0.08	0.05	0.599	2
		140300036302	Leopard Ck	7,507	0.31	0.31	0.01	0.02	0.12	0.17	0.00	0.00	0.17	0.01	0.27	0.03	0.05	0.602	2
		140300036303	Upper San Miguel Rvr C	32,669	0.46	0.46	0.00	0.01	0.17	0.25	0.03	0.04	6.99	0.58	0.86	0.09	0.13	1.561	4

Appendix C - Watershed Activity Variables

		140300036304	South Fk San Miguel Rvr	37,144	0.23	0.23	0.01	0.05	0.20	0.29	0.01	0.01	5.29	0.44	1.22	0.13	0.20	1.352	4
		140300036305	Deep Ck	9,079	0.22	0.22	0.00	0.00	0.31	0.45	0.00	0.00	0.85	0.07	0.40	0.04	0.10	0.892	3
		140300036306	Bilk Ck	8,095	0.21	0.21	0.00	0.00	0.27	0.39	0.00	0.00	2.06	0.17	0.42	0.05	0.10	0.927	3
		140300036307	Bear Ck	6,431	0.22	0.22	0.00	0.00	0.28	0.41	0.00	0.00	1.29	0.11	1.02	0.11	0.21	1.061	4
		140300036308	Fall Ck	17,232	0.23	0.23	0.00	0.01	0.20	0.29	0.01	0.01	0.15	0.01	0.67	0.07	0.14	0.776	3
1403000365	Horsefly Ck	140300036501	Horsefly Ck C	11,147	0.01	0.01	0.00	0.00	0.00	0.00	0.13	0.21	0.00	0.00	1.41	0.15	0.13	0.501	2
		140300036502	Sheep Ck	4,431	0.25	0.25	0.00	0.00	0.10	0.14	0.18	0.30	0.00	0.00	2.23	0.24	0.29	1.217	3
		140300036503	Red Ck	8,260	0.03	0.03	0.00	0.00	0.06	0.09	0.12	0.19	0.00	0.00	2.48	0.27	0.37	0.950	3
		140300036504	Little Red Canyon	7,875	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.16	0.00	0.00	2.31	0.25	0.25	0.660	2
		140300036505	Hanks Ck	5,035	0.18	0.18	0.00	0.00	0.07	0.10	0.10	0.16	0.00	0.00	2.66	0.29	0.23	0.951	3
		140300036506	Clear Ck	5,094	0.12	0.12	0.00	0.00	0.23	0.34	0.16	0.26	0.00	0.00	2.74	0.30	0.61	1.630	4
		140300036507	Upper Horsefly Ck	9,539	0.23	0.23	0.00	0.00	0.10	0.14	0.04	0.07	0.00	0.00	2.44	0.27	0.35	1.059	3
		140300036508	Albin Draw	5,659	0.32	0.32	0.00	0.00	0.00	0.00	0.18	0.30	0.00	0.00	2.04	0.22	0.21	1.043	4
1403000367	Tabeguache Ck	140300036701	Tabeguache Ck	47,705	0.04	0.04	0.00	0.00	0.00	0.01	0.07	0.11	0.03	0.00	1.31	0.14	0.14	0.438	2
		140300036702	Shavano Ck	3,646	0.00	0.00	0.00	0.00	0.10	0.15	0.00	0.00	0.00	0.00	0.60	0.07	0.17	0.383	2
		140300036703	Campbell Ck	7,360	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.08	0.09	0.169	1
		140300036704	Spring Ck	4,685	0.00	0.00	0.00	0.00	0.08	0.12	0.00	0.00	0.00	0.00	2.07	0.23	0.40	0.747	3
1403000442	Blue Ck	140300044201	Upper Blue Ck	12,660	0.02	0.02	0.00	0.00	0.00	0.00	0.10	0.16	0.00	0.00	1.41	0.15	0.17	0.495	2
		140300044202	Calamity Ck	19,448	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.00	1.39	0.15	0.26	0.440	2
		140300044203	MaveriCk Canyon	2,156	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.48	0.00	0.00	3.01	0.33	0.41	1.210	3
1403000443	Mesa Ck	140300044301	North Fk Mesa Ck	12,767	0.05	0.05	0.00	0.00	0.00	0.00	0.05	0.09	0.00	0.00	2.08	0.23	0.36	0.718	3
		140300044302	South Fk Mesa Ck	6,463	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01	1.97	0.21	0.12	0.340	1
1403000469	West Ck	140300046901	Upper West Ck	29,860	0.06	0.06	0.00	0.00	0.04	0.06	0.00	0.00	0.00	0.00	1.30	0.14	0.21	0.468	2
		140300046902	Ute Ck	5,465	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.62	0.07	0.10	0.177	1
		140300046903	Wright/Casto Draws C	166	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.02	0.00	0.015	1

Appendix D - Comprehensive Assessment Results Summary

HUC5	HUC5_NAME	HUC6	HUC6_NAME	nf acres	Sensitivity Total	Sensitivity Class	Activity Class	Activity Class	Integrity Produc	Integrity Class
1401000517	Plateau Ck	140100051701	Lower Plateau C	6,013	2.98	4	0.11	1	0.32	1
		140100051702	Anderson Gulch	3,656	2.94	4	0.16	4	0.47	4
		140100051703	Kimball Ck	4,783	2.05	4	0.27	1	0.56	1
		140100051704	Mid Plateau Ck C	491	0.78	1	0.16	1	0.12	1
		140100051705	Upper Plateau Ck	9,577	1.69	3	0.35	2	0.59	1
		140100051706	Park Ck	5,381	2.1	4	0.33	1	0.69	1
		140100051707	Leon Ck	27,684	1.69	3	0.88	3	1.49	3
		140100051708	Salt Ck	2,358	1.45	2	0.23	1	0.34	1
		140100051709	Grove Ck	6,115	1.22	2	0.42	2	0.51	1
		140100051710	Big Ck	15,468	1.51	3	1.53	4	2.32	3
		140100051711	Deacon Gulch	390	1.27	2	0.12	1	0.15	1
		140100051712	Cottonwood Ck	10,679	1.32	2	1.37	4	1.81	3
		140100051713	Bull Ck	9,257	1.2	2	0.59	2	0.71	2
		140100051714	Spring Ck	2,532	0.97	1	0.58	4	0.57	4
		140100051715	Coon Ck	3,758	1.26	2	0.57	2	0.71	2
		140100051716	Mesa Ck	7,677	1.24	2	1.37	4	1.7	3
1401000519	Buzzard Ck	140100051901	Lower Buzzard C	11,542	1.41	2	0.6	2	0.85	2
		140100051902	Harrison Ck	1,986	1.28	2	0.3	1	0.38	1
		140100051903	Hawxhurst Ck	6,608	1.4	2	0.29	1	0.41	1
		140100051904	Brush Ck	8,380	1.8	3	0.76	3	1.36	2
		140100051905	Road Gulch	6,603	1.3	2	0.73	3	0.96	2
		140100051906	Upper Buzzard Ck	45,725	1.6	3	0.82	3	1.32	2
1402000195	Taylor Rvr	140200019501	Lower Taylor Rvr C	38,325	1.78	3	1.03	3	1.83	3
		140200019502	Beaver Ck	18,335	1.72	3	0.45	2	0.78	2
		140200019503	Crystal Ck	14,314	1.66	3	0.01	1	0.01	1
		140200019504	Lottis Ck	26,975	2.05	4	0.36	2	0.74	2
		140200019505	Spring Ck	43,940	1.7	3	1.12	3	1.91	3
		140200019506	Mid Taylor Rvr C	56,061	1.69	3	0.98	3	1.65	3
		140200019507	Willow Ck	40,620	2.09	4	1.01	3	2.11	3
		140200019508	Texas Ck	25,945	2.51	4	0.84	3	2.12	3
		140200019509	Upper Taylor Rvr	39,910	2.1	4	0.66	2	1.38	2
1402000199	East Rvr	140200019901	Lower East Rvr C	10,829	1.7	3	0.49	2	0.82	2

Appendix D - Comprehensive Assessment Results Summary

		140200019902	Roaring Judy Ck	6,035	1.54	3	0.66	2	1.02	2
		140200019903	Alkali Ck	7,413	1.25	2	0.33	1	0.41	1
		140200019904	Cement Ck	21,953	2.05	4	1.33	4	2.72	3
		140200019905	Farris Ck	4,267	2.16	4	0.36	2	0.79	2
		140200019906	Brush Ck	24,673	2.12	4	0.42	2	0.89	2
		140200019907	Mid East Rvr C	15,769	2.78	4	1.51	4	4.2	4
		140200019908	Slate Rvr	45,688	2.03	4	1.92	4	3.9	4
		140200019909	Copper Ck	5,886	2.27	4	1.93	4	4.37	4
		140200019910	Upper East Rvr	11,334	2.47	4	1.53	4	3.78	4
1402000201	Ohio Ck	140200020101	Lower Ohio Ck C	16,593	0.93	1	0.47	2	0.44	1
		140200020102	Willow Ck	3,229	1.14	2	0.73	3	0.83	2
		140200020103	Carbon Ck	11,952	1.63	3	0.53	2	0.86	2
		140200020104	Upper Ohio Ck	7,769	1.55	3	0.66	2	1.03	2
		140200020105	Pass Ck	6,487	1.22	2	0.18	1	0.22	1
		140200020106	Castle Ck	14,099	2	4	0.11	1	0.23	1
		140200020107	Mill Ck	8,407	1.83	3	0.32	1	0.59	1
1402000203	Soap/Antelope Cks C	140200020301	Soap Ck	51,802	1.98	4	0.22	1	0.43	1
		140200020302	West Elk Ck	19,072	2.23	4	0.03	1	0.07	1
		140200020303	Red Ck	4,963	1.58	3	1.28	4	2.02	3
		140200020304	Dry Gulch	74	0.82	1	0	1	0	1
		140200020305	East Elk Ck	10,231	1.89	3	0.57	2	1.08	2
		140200020306	Dry Ck	171	0.57	1	2.05	4	1.18	2
		140200020307	Willow Ck	4,627	1.56	3	1.07	3	1.67	3
		140200020308	Stevens Ck	2,881	1.15	2	0.69	2	0.8	2
		140200020309	Steuben Ck	13,322	1.59	3	0.42	2	0.66	1
		140200020310	Beaver Ck	17,286	1.98	4	0.04	1	0.09	1
		140200020311	Antelope Ck	4,492	1.41	2	1.16	3	1.63	3
1402000205	Smith Fk/Crawford Res.	140200020501	Smith Fk	37,451	1.75	3	0.19	1	0.33	1
		140200020502	Muddy Ck	5,229	1.14	2	0.41	2	0.47	1
1402000207	Blue Mesa Res./Upper Gunnison Rvr C	140200020704	Blue Mesa Res. C	795	1.85	3	0.14	1	0.26	1
1402000210	BlaCk Canyon C	140200021001	Spring/Pool Gulches C	13	0.43	1	0	1	0	1
1402000249	Blue/Pine Cks	140200024901	Big Blue	27,470	2.11	4	0.29	1	0.6	1
		140200024902	Little Blue	2,521	0.75	1	1.56	4	1.17	2
		140200024903	Pine Ck	120	0.49	1	0.31	1	0.15	1
1402000250	South Beaver Ck	140200025001	Upper South Beaver	16,589	1.01	1	0.12	1	0.13	1
		140200025002	Lower South Beaver	387	1.19	2	0.54	2	0.65	1
1402000253	Crystal/Curecanti Cks C	140200025301	Crystal Ck C	29,757	1.39	2	0.44	2	0.61	1
		140200025302	Long Gulch	1,940	1.25	2	0.47	2	0.59	1

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		140200025303	Mesa Ck	7,126	0.97	1	1.18	3	1.14	2
		140200025304	Myers Gulch	3,427	0.92	1	0.74	3	0.68	1
		140200025305	Curecanti Ck	21,136	2.02	4	0.51	2	1.02	2
		140200025306	Corral Ck	1,687	0.9	1	0.66	2	0.59	1
		140200025307	Haypress Ck	649	0.88	1	0.82	3	0.72	2
		140200025308	Cottonwood Gulch	1,233	0.83	1	0.58	2	0.48	1
1402000254	Gunnison Rvr C	140200025401	Gunnison Rvr C	5,632	1.54	3	1.55	4	2.39	3
		140200025402	Leaps Gulch	5,852	1.03	1	0.66	2	0.68	1
		140200025403	Fischer Gulch	2,629	1.01	1	0.72	3	0.73	2
1402000281	Cimarron Rvr	140200028101	Cimarron Rvr	46,322	2.2	4	0.43	2	0.94	2
		140200028102	Little Cimarron Rvr	17,645	1.88	3	0.79	3	1.48	3
1402000283	Lake Fk Gunnison Rvr	140200028301	Lower Lake Fk C	33,943	1.56	3	0.16	1	0.25	1
		140200028302	Hensen Ck	18,408	1.99	4	0.46	2	0.92	2
		140200028303	Upper Lake Fk	19,861	2.15	4	0.28	1	0.6	1
		140200028304	Willow Ck	1,948	0.61	1	0.47	2	0.29	1
1402000285	Cebolla Ck	140200028501	Rock Ck/Fish Canyon C	5,501	0.95	1	0.39	2	0.37	1
		140200028502	Upper Cebolla Ck	97,690	1.54	3	0.4	2	0.61	1
		140200028503	Powderhorn Ck	646	0.88	1	0	1	0	1
1402000351	Razor Ck	140200035101	Upper Razor Ck	22,203	1.88	3	0.61	2	1.14	2
		140200035102	Prosser Ck	2,547	1.4	2	0.89	3	1.25	2
		140200035103	Lower Razor Ck C	1,270	0.96	1	1.35	4	1.29	2
1402000387	Cochetopa Ck	140200038701	Upper Cochetopa Ck	82,959	1.54	3	0.54	2	0.84	2
		140200038702	Los Pinos Ck	43,020	1.32	2	0.56	2	0.73	2
		140200038703	West Pass Ck	27,621	1.5	3	1.24	4	1.87	3
		140200038704	Lower Cochetopa Ck C	10,562	1.02	1	0.5	2	0.51	1
1402000389	Lower Tomichi Ck C	140200038901	Mid Tomichi Ck C	47,245	1.66	3	0.77	3	1.28	2
		140200038902	Hot Spring Ck	21,241	1.38	2	1.43	4	1.97	3
		140200038903	Wood Gulch	2,163	1.05	1	0.66	2	0.7	1
		140200038904	Sewell Gulch	1,651	1.08	2	0.23	1	0.25	1
		140200038905	Cabin Ck	3,823	0.92	1	0.61	2	0.56	1
		140200038906	Stubbs Gulch	2,605	1.15	2	0.42	2	0.48	1
		140200038907	Lower Tomichi C	222	0.52	1	0.34	1	0.18	1
1402000391	Upper Tomichi Ck	140200039101	Long Branch Ck	15,490	1.76	3	0.5	2	0.88	2
		140200039102	Marshall Ck	36,632	1.78	3	1.17	3	2.09	3
		140200039103	Upper Tomichi Ck	58,230	2.15	4	0.89	3	1.92	3
1402000393	Quartz Ck	140200039301	Lower Quartz Ck C	24,534	2.25	4	1.58	4	3.55	4
		140200039302	Alder Ck	7,990	1.63	3	0.64	2	1.04	2
		140200039303	Gold Ck	19,457	2.03	4	1.67	4	3.39	4

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		140200039304	Upper Quartz Ck	25,919	2.29	4	1.7	4	3.89	4
1402000407	Anthracite Ck	140200040701	Anthracite Ck	80,009	1.79	3	0.53	2	0.94	2
		140200040702	Coal Ck	64,655	1.75	3	0.22	1	0.38	1
1402000409	East Muddy Ck	140200040901	Lower East Muddy Ck C	17,378	1.79	3	0.23	1	0.42	1
		140200040902	Lee Ck	12,532	1.56	3	0.32	1	0.5	1
		140200040903	Clear Fk East Muddy Ck	24,694	1.53	3	0.25	1	0.38	1
		140200040904	Little Muddy Ck	10,395	1.48	3	0.43	2	0.63	1
		140200040905	Little Henderson Ck	5,296	1.44	2	0.83	3	1.19	2
1402000411	North Fk Gunnison Rvr C	140200041101	North Fk Gunnison Rvr C	24,172	1.57	3	0.29	1	0.45	1
		140200041102	Minnesota Ck	23,910	1.47	3	0.67	2	0.98	2
		140200041103	Terror Ck	13,992	1.31	2	0.74	3	0.97	2
		140200041104	Paonia Reservoir C	5,846	1.67	3	0.32	4	0.53	4
1402000455	West Muddy Ck	140200045501	Lower West Muddy Ck C	23,356	1.07	2	0.41	2	0.44	1
		140200045502	Upper West Muddy Ck	20,240	1.42	2	0.42	2	0.6	1
		140200045503	Cow Ck	11,599	1.43	2	0.78	3	1.12	2
1402000456	Hubbard Ck	140200045601	Lower Hubbard Ck C	8,599	1.46	3	0.37	2	0.54	1
		140200045602	Upper Hubbard Ck	13,052	1.55	3	0.5	2	0.77	2
		140200045603	Alder Ck	5,676	1.12	2	0.65	2	0.72	2
1402000458	Leroux/Cottonwood Cks C	140200045801	East Leroux Ck	22,383	1.46	3	0.89	3	1.3	2
		140200045803	West Roatcap Ck	311	0.91	1	0.24	1	0.22	1
		140200045806	Reynolds Ck	1,948	1.52	3	0.14	1	0.21	1
		140200045807	Cottonwood Ck	4,882	1.09	2	0.38	4	0.41	4
		140200045808	Bell Ck	2,986	1.3	2	0.34	1	0.44	1
1402000509	Wells/Alkali Cks C	140200050901	Petrie Mesa	40	0.71	1	0.45	2	0.32	1
		140200050902	Alkali Ck	2,297	1.22	2	0.27	1	0.33	1
		140200050905	Wells Gulch	3,443	1.53	3	0.05	1	0.07	1
1402000513	Tongue/Currant Cks C	140200051301	Dry Gulch	1,011	0.92	1	1.19	4	1.09	4
		140200051302	Negro Ck	54	0.51	1	0.29	1	0.15	1
		140200051303	Doughspoon Ck	2,552	1.02	1	1.37	4	1.39	2
		140200051304	Oak Ck	4,838	1.04	1	1.48	4	1.54	3
		140200051305	Dirty George Ck	9,698	1.07	2	0.82	3	0.88	2
		140200051306	Ward Ck	9,076	1.13	2	1.32	4	1.49	3
		140200051307	Kiser Ck	8,884	1.21	2	2.16	4	2.63	3
		140200051308	Milk Ck	3,021	1.45	3	0.35	2	0.51	1
		140200051309	Surface Ck	16,757	1.56	3	1.08	3	1.68	3
		140200051310	Currant Ck	7,369	1.3	2	0.08	1	0.1	1
1402000515	Kannah/Whitewater Cks C	140200051501	Kannah Ck	49,460	1.36	2	0.66	2	0.89	2
		140200051502	Whitewater Ck	3,522	1.43	2	0.37	2	0.53	1

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		140200051503	Deer Ck	1,885	1.4	2	0	1	0	1
1402000540	East Ck	140200054001	Upper East Ck	1,634	1.2	2	0.45	2	0.54	1
		140200054002	Gibbler Gulch	475	1.47	3	0.33	1	0.48	1
		140200054003	North East Ck	3,258	0.88	1	0.53	2	0.47	1
		140200054005		7	0.61	1	1	3	0.61	1
1402000573	Dominguez Ck	140200057301	Big Dominguez	33,223	1.43	2	0.41	2	0.58	1
		140200057302	Little Dominguez	22,562	1.26	2	0.26	1	0.33	1
1402000575	Escalante Ck	140200057501	Escalante Ck (Ouray & G.V.)	54,756	1.8	3	0.47	2	0.85	2
		140200057502	N Fk Escalante Ck	19,063	1.49	3	0.37	2	0.55	1
		140200057503	Dry Fk Escalante Ck	16,197	1.41	2	0.75	3	1.06	2
		140200057504		24	0.95	1	0	1	0	1
1402000577	Roubideau Ck	140200057701	Roubideau Ck	51,795	1.61	3	0.54	2	0.87	2
		140200057702	Potter Ck	21,886	1.29	2	0.92	3	1.18	2
		140200057703	Cottonwood Ck	9,613	1.13	2	0.94	3	1.07	2
1402000640	Spring Ck/Happy Canyon C	140200064001	Spring Ck	17,878	1.15	2	1.03	3	1.19	2
		140200064002	Happy Canyon Ck	6,554	0.96	1	0.93	3	0.88	2
		140200064003	Horsefly Ck	11	0.47	1	1.06	3	0.5	1
1402000648	Cow Ck	140200064801	Upper Cow Ck	28,320	2.51	4	0.17	1	0.42	1
		140200064802	Owl Ck	4,238	1.48	3	0.66	2	0.98	2
		140200064803	Nate Ck	3,270	1.54	3	0.72	3	1.1	2
		140200064804	Lou Ck	5,263	1.34	2	0.37	2	0.49	1
		140200064805	Deer Ck	855	1.53	3	0.22	1	0.34	1
		140200064806	Burro Ck	757	1.52	3	1.13	3	1.73	3
		140200064807	Lower Cow Ck C	33	0.46	1	0	1	0	1
1402000650	Dry Ck	140200065001	East Fk Dry Ck	16,385	0.95	1	1.44	4	1.37	2
		140200065002	Coalbank/Big Sandy	2,334	1.37	2	1.84	4	2.52	3
		140200065003	Roatcap Gulch	1,861	1.08	2	1.23	4	1.33	2
1402000679	Upper Uncompahgre Rvr	140200067901	Upper Uncompahgre Rvr	63,451	2.59	4	1.7	4	4.4	4
		140200067902	Dry Ck	1,199	1.29	2	0	1	0	1
		140200067903	East Fk Dallas Ck	12,263	2.13	4	0.62	2	1.32	2
		140200067904	West Fk Dallas Ck	7,240	1.74	3	0.52	2	0.9	2
1403000171	Little Dolores Rvr	140300017101	Upper Little Dolores Rvr	3,558	1.08	2	0.2	1	0.21	1
1403000345	Coal/Cottonwood Cks C	140300034501	Cottonwood Ck	29,141	1.3	2	0.88	3	1.15	2
		140300034502	Bucktail Cks C	8,579	1.28	2	1.04	4	1.34	4
		140300034503	Tuttle/Bramier Draws C	557	1.52	3	0.51	2	0.77	2
		140300034505	Coal Ck	4,336	1.49	3	0.69	2	1.02	2
		140300034507	Atkinson Ck	5,979	1.85	3	0.5	2	0.92	2
1403000347	Beaver/Mckenzie Cks C	140300034701	Beaver Ck	28,561	1.48	3	0.75	4	1.11	4

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		140300034702	Saltado Ck	6,271	1.36	2	1.28	4	1.73	3
		140300034703	Specie Ck	1,044	0.95	1	0.84	3	0.8	2
		140300034704	McKenzie Ck	15,389	1.56	3	0.84	3	1.32	2
		140300034705	Clay Ck	15,433	1.35	2	0.77	3	1.03	2
		140300034706	Beaver McKenzie C	14,680	1.27	2	0.77	3	0.98	2
1403000361	Naturita Ck	140300036101	Naturita Ck	19,497	2.11	4	0.63	2	1.33	2
		140300036102	McKee Draw	4,337	1.21	2	1.89	4	2.29	4
		140300036103	Burn Canyon	823	0.99	1	1.27	4	1.25	4
		140300036104	Callan Draw	5,614	1.42	2	0.74	4	1.05	4
		140300036105	Hamilton Ck	618	1.09	2	1.45	4	1.58	4
		140300036106	Maverick Draw	3,236	1.13	2	1.33	4	1.5	3
1403000363	Upper San Miguel Rvr	140300036301	Mid San Miguel Rvr C	3,636	1.76	3	0.6	2	1.05	2
		140300036302	Leopard Ck	7,507	1.63	3	0.6	2	0.98	2
		140300036303	Upper San Miguel Rvr C	32,669	2.19	4	1.56	4	3.42	4
		140300036304	South Fk San Miguel Rvr	37,144	2.09	4	1.35	4	2.83	4
		140300036305	Deep Ck	9,079	1.91	3	0.89	3	1.71	3
		140300036306	Bilk Ck	8,095	1.77	3	0.93	3	1.64	3
		140300036307	Bear Ck	6,431	1.52	3	1.06	4	1.61	4
		140300036308	Fall Ck	17,232	1.51	3	0.78	3	1.17	2
1403000365	Horsefly Ck	140300036501	Horsefly Ck C	11,147	1.55	3	0.5	2	0.77	2
		140300036502	Sheep Ck	4,431	1.12	2	1.22	3	1.37	2
		140300036503	Red Ck	8,260	1.24	2	0.95	3	1.18	2
		140300036504	Little Red Canyon	7,875	1.03	1	0.66	2	0.68	1
		140300036505	Hanks Ck	5,035	1.05	1	0.95	3	1	2
		140300036506	Clear Ck	5,094	1	1	1.63	4	1.63	3
		140300036507	Upper Horsefly Ck	9,539	1.16	2	1.06	3	1.23	2
		140300036508	Albin Draw	5,659	1.56	3	1.04	4	1.63	4
1403000367	Tabeguache Ck	140300036701	Tabeguache Ck	47,705	1.53	3	0.44	2	0.67	1
		140300036702	Shavano Ck	3,646	2.24	4	0.38	2	0.86	2
		140300036703	Campbell Ck	7,360	2.17	4	0.17	1	0.37	1
		140300036704	Spring Ck	4,685	2.12	4	0.75	3	1.59	3
1403000442	Blue Ck	140300044201	Upper Blue Ck	12,660	1.48	3	0.5	2	0.73	2
		140300044202	Calamity Ck	19,448	1.77	3	0.44	2	0.78	2
		140300044203	MaveriCk Canyon	2,156	1.7	3	1.21	3	2.05	3
1403000443	Mesa Ck	140300044301	North Fk Mesa Ck	12,767	1.37	2	0.72	3	0.98	2
		140300044302	South Fk Mesa Ck	6,463	1.43	2	0.34	1	0.49	1
1403000469	West Ck	140300046901	Upper West Ck	29,860	2.32	4	0.47	2	1.08	2
		140300046902	Ute Ck	5,465	1.73	3	0.18	1	0.31	1

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		140300046903	Wright/Casto Draws C	166	2.48	4	0.02	1	0.04	1

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